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ANGIOSTRONGYLUS

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Angiostrongylus spp.

- 1623—ALICATA, J. E., 1969. "On the identity of *Angiostrongylus* from rats in Brisbane, Australia, and on the life history of *Angiostrongylus cantonensis*." *J. Parasit.*, 55 (2), 323.

Angiostrongylus sp. from rats from Brisbane, southern Queensland, Australia, have shorter spicules (0.49 mm.) than those from rats in northern Queensland and the islands of the Pacific and Indian oceans. Since the rat lungworms from Brisbane have recently been shown to represent both *A. cantonensis* and *A. mackerrasae* [see *Helminth. Abstr.*, Ser. A, 39, No. 439] it is not certain if the life-cycle, elucidated from rats in this area [see *Helminth. Abstr.*, 24, No. 10a], was that of *A. cantonensis* or *A. mackerrasae* or a mixture of both.

P.S.G.

- 4660—DROZDZ, J., 1970. "Révision de la systématique du genre *Angiostrongylus* Kamensky 1905 (Nematoda: Metastrongyloidea)." *Annls Parasit. hum. comp.*, 45 (5), 597-603. [English summary pp. 597-598.]

Angiostrongylus is revised and divided into 2 subgenera, *A.* (*Angiostrongylus*) n.subg. and *A.* (*Parastrongylus*) n.subg. *A.* (*A.*) *vasorum* is designated type of the former which also includes *A.* (*A.*) *raillieti*, *A.* (*A.*) *gubernaculatus* and *A.* (*A.*) *chabaudi*. *A.* (*P.*) *tateronae* is type of the latter which also includes *A.* (*P.*) *ondatrae*, *A.* (*P.*) *cantonensis*, *A.* (*P.*) *sciuri*, *A.* (*P.*) *mackerrasae*, *A.* (*P.*) *sandarsae* and *A.* (*P.*) *dujardini*. *Stefanskostrongylus* n.g. is proposed for those species of *Angiostrongylus* parasitic in the lungs of insectivores, namely, *S. michiganensis* n. comb. (type), *S. soricis* n. comb. and *S. blarini* n. comb. The 2 genera may be distinguished morphologically by the arrangement and relative size of the lateral and dorsal rays in the male bursa. A footnote records that since submitting this manuscript 2 other species have been described, *Rattostrongylus petrovi* Tardzhimanova & Chertkova, 1969, the description of which proved to be unobtainable to the author, and a species from Costa Rica, probably from man.

S.W.

- 968—GUILHON, J., 1971. [Role of animals in the actiology and epidemiology of new zoonoses: the angiostrongyloses.] "Rôle des animaux dans l'étiologie et l'épidémiologie de nouvelles zoonoses: les angiostrongyloses." *Bull. Acad. natn. Méd.*, 155 (11/12), 223-229. [Discussion pp. 229-232.]

- 4668—KINSELLA, J. M., 1971. "*Angiostrongylus schmidtii* sp.n. (Nematoda: Metastrongyloidea) from the rice rat, *Oryzomys palustris*, in Florida, with a key to the species of *Angiostrongylus* Kamensky, 1905." *J. Parasit.*, 57 (3), 494-497.

Angiostrongylus schmidtii n.sp. from the pulmonary arteries of *Oryzomys palustris* in Florida, USA, is distinguished from *A. tateronae* and *A. sandarsae* by its shorter spicules and larger ventro-ventral ray. A key to the species of *Angiostrongylus* is given.

[A.S.] M.R.N.S.

Angiostrongylus cantonensis

1031—ALICATA, J. E., 1962. "*Angiostrongylus cantonensis* (Nematoda: Metastrongylidae) as a causative agent of eosinophilic meningoencephalitis of man in Hawaii and Tahiti." *Canadian Journal of Zoology*, 40 (1), 5-8.

In Hawaii where rats have been found infected with *Angiostrongylus cantonensis* [see abstract No. 1660 below], Alicata found *Achatina fulica* and *Veronicella leydigi* harbouring infective larvae of this nematode. *Geoplana septemlineata* was also found naturally infected but, unlike *A. fulica*, *V. leydigi*, *Eulota similis* and *Subulina octona*, it could not be experimentally infected with first-stage larvae and is thought to be a carrier host. Laboratory rats were successfully infected by feeding them fragments of infected molluscs and planarians. In connection with the outbreak of eosinophilic meningoencephalitis among Tahitians reported by Rosen *et al.* (1961) [see abstract No. 1062 below] it was Alicata who drew to their attention the death from this disease of a Filipino on Honolulu in whose brain were subsequently found adult *A. cantonensis*. A few days after eating 2 raw *Veronicella* slugs another patient on Honolulu developed generalized pain and hyperaesthesia of the ears, back of the head, shoulders and extremities. 5 weeks later he showed a 16% blood eosinophilia, a pleocytosis of 284 cells per cu.mm. of cerebrospinal fluid, of which 25% were eosinophils, and gave a positive reaction to an intradermal test in which an *Angiostrongylus* antigen was used. *Veronicella* slugs in the area were shown to be infected. Infective larvae were fed to a squirrel monkey by stomach tube; at autopsy 5 days later developing larvae were found in the brain. 62 of 70 rats collected in 6 districts on Tahiti were infected and infective larvae were found in land snails, slugs and land planarians collected in 4 districts. Preliminary experiments indicate that the infective larvae of *A. cantonensis* may be able to penetrate the intact skin of guinea-pigs and rats [but see abstract No. 1032 below]. When intradermal tests were made on 9 persons with a history of eosinophilic meningoencephalitis using an *Angiostrongylus* antigen all gave a positive reaction [see also abstract No. 1446 below]. *A. cantonensis* is believed to be the causative agent of eosinophilic meningoencephalitis of man in Hawaii and Tahiti. [See also abstract No. 1487 below.] J.W.S.

1487—ALICATA, J. E., 1962. "Observations on the occurrence of the rat-lungworm, *Angiostrongylus cantonensis* in New Caledonia and Fiji." *Journal of Parasitology*, 48 (4), 595.

Ten undetermined species of rats collected in New Caledonia were found to be heavily infected with *Angiostrongylus cantonensis*. Rats from Suva (Fiji) were not found to be infected. Specimens of the land slug, *Vaginulus plebeius*, from both areas harboured 3rd-stage nematode larvae morphologically identical with those of *A. cantonensis*. *A. cantonensis* has previously been recorded from Australia, China, Formosa, Guam, Hawaiian Islands, Ponape, Tahiti and Truk Islands. M.B.-B.

3022—ALICATA, J. E., 1963. "The incidence of *Angiostrongylus cantonensis* (Chen) among rats and mollusks in New Caledonia and nearby islands and its possible relation to eosinophilic meningitis." Noumea, New Caledonia: South Pacific Commission, Technical Paper No. 139, iii+9 pp.

Two hundred and ten rats (*Rattus norvegicus*, *R. rattus alexandrinus*, *R. rattus rattus* and *R. exulans*) were trapped on New Caledonia, New Hebrides and the Loyalty Islands. 78.1% harboured adult *Angiostrongylus cantonensis* in the pulmonary arteries. Infective larvae of this lungworm were found in the slugs *Agriolimax laevis*, *Vaginulus plebeius* and *Veronicella alte*, and in the snails *Bradybaena similis* and *Subulina octona*. Undetermined species of land planarians also harboured infective larvae and may serve as paratenic hosts. Most of the human cases of eosinophilic meningitis reported in New Caledonia in recent years occurred between July and November. This period corresponds to the cooler months of the year when vegetables are most commonly grown and eaten and when there is probably an increase in the activity and reproduction of molluscs and planarians. Infection may result from accidentally eating infected molluscs and planarians on inadequately washed lettuce or other vegetables. Other possible sources of human infection are discussed, including fresh-water prawns eaten raw. In an introduction to this paper, Loison points out that the occurrence of eosinophilic meningitis among the various human population groups in the South Pacific does not show a simple relationship to the consumption or non-consumption of leaf vegetables or raw fresh-water prawns. J.W.S.

1570—ALICATA, J. E., 1963. "Morphological and biological differences between the infective larvae of *Angiostrongylus cantonensis* and those of *Anafilaroides rostratus*." *Canadian Journal of Zoology*, 41 (7), 1179-1183.

Infective larvae of *Angiostrongylus cantonensis* are 460 to 510 μ in length, the oesophagus 171 to 198 μ long, and the genital primordium 120 to 135 μ from the anus. Infective larvae of *Anafilaroides rostratus* are 545 to 655 μ in length, the oesophagus 218 to 246 μ long, and the genital primordium 37 to 153 μ from the anus. Larvae of *A. rostratus* encyst in the liver of rats and mice and do not migrate to the central nervous system of cats. R.C.A.

119—ALICATA, J., 1963. "Experimental work on eosinophilic meningitis." *Plantn Hlth*, 28 (2), 17-23.

A summary is given of studies in the University of Hawaii on the rat lungworm (*Angiostrongylus cantonensis*), in connection with human eosinophilic meningitis. J.E.P.

1611—ALICATA, J. E., 1963. "Incapability of vertebrates to serve as paratenic host for infective

larvae of *Angiostrongylus cantonensis*." [Abstract.] *Journal of Parasitology*, 49 (5, Sect. 2), 48.

Infective larvae of *Angiostrongylus cantonensis* were given to 5 chicks and 2 calves. Larvae were not recovered from the tissues 15 days later. R.C.A.

457—ALICATA, J. E., 1964. "Land crabs as probable paratenic hosts for the infective larvae of *Angiostrongylus cantonensis*." [Abstract.] *J. Parasit.*, 50 (3, Sect. 2), 39.

458—ALICATA, J. E., 1964. "Pigs and calves as carrier hosts for the infective larvae of *Angiostrongylus cantonensis*." [Abstract.] *J. Parasit.*, 50 (3, Sect. 2), 39.

1276—ALICATA, J. E., 1965. "Biology and distribution of the rat lungworm, *Angiostrongylus cantonensis*, and its relationship to eosinophilic meningoencephalitis and other neurological disorders of man and animals." *Adv. Parasitol.*, 3, 223-248.

Alicata reviews published work on the biology of *Angiostrongylus cantonensis* and its relationship to neurological disease in man and animals. He stresses the need for (i) a simple method to diagnose the infection in man (perhaps using a purified worm antigen suitable for cutaneous tests), (ii) more information on animals serving as carrier hosts and on the methods of human infection and (iii) further studies on the effect of the parasite on primates and other mammals, with special reference to neurological and related disorders. R.C.A.

1136—ALICATA, J. E., 1965. "Notes and observations on murine angiostrongylosis and eosinophilic meningoencephalitis in Micronesia." *Can. J. Zool.*, 43 (5), 667-672.

On average, 32.8% of rats in the Micronesian islands, mainly *Rattus rattus*, were infected with *Angiostrongylus cantonensis*. Infective larvae were found in the crustaceans *Birgus latro*, *Cardisoma hirtipes* and *Macrobrachium* sp. as well as in the molluscs *Achatina fulica*, *Vaginulus plebeius*, *Subulina octona*, *Opeas javanicum*, *Bradybaena similis* and *Pupina complanata*. Human infections reported in Micronesia may have resulted from eating raw crustaceans. R.C.A.

2563—ALICATA, J. E., 1965. "Occurrence of *Angiostrongylus cantonensis* in Madagascar, Mauritius, Ceylon, and Sarawak." *J. Parasit.*, 51 (6), 937.

Angiostrongylus cantonensis is reported from wild rats, *Rattus* sp., in Madagascar, Mauritius, Ceylon and Sarawak and from *Bandicota* sp. in Ceylon. *A. cantonensis* may have spread from East Africa to many of the Pacific Islands by the same route as *Achatina fulica*. T.Y.

1379—ALICATA, J. E., 1966. "The presence of *Angiostrongylus cantonensis* in islands of the Indian Ocean and probable role of the giant African snail, *Achatina fulica*, in dispersal of the parasite to the Pacific Islands." *Can. J. Zool.*, 44 (6), 1041-1049.

The incidence of *Angiostrongylus cantonensis* in Madagascar, Mauritius, Ceylon, and Sarawak is reported for the first time. The presence of the parasite in these areas and the comparatively recent occurrence of murine and human angiostrongylosis in South-East Asia and the Pacific suggested that the parasite was introduced to these areas from the islands of the Indian Ocean. The fact that *Achatina fulica* during the past 2 centuries has gradually spread eastward from East Africa to the Pacific Islands leads to speculation that it might have been important in the spread of the parasite. Supporting evidence includes finding *Angiostrongylus cantonensis* along the same dispersal route as that of *Achatina fulica*, finding the parasite among rats in parts of Asia and the Pacific after the introduction of the snail, and the existence of a comparatively close time relationship between the first appearance of the *Achatina* snail in the Pacific Islands and the first occurrence of eosinophilic meningitis in this area. [A.S.] M.B-B.

5025—ALICATA, J. E., 1966. "Biology and distribution of the rat lungworm, *Angiostrongylus cantonensis*, and its relation to eosinophilic meningoencephalitis and other neurological disorders of man and animals." *Int. Congr. Parasit.* (1st), Rome, Sept. 21-26, 1964. Proceedings, Vol. II, pp. 826-828. [Discussion p. 839.]

1058—ALICATA, J. E., 1967. "Absence of *Angiostrongylus cantonensis* among rodents in parts of Central and South America." *J. Parasit.*, 53 (5), 118.

Nearly 2,000 rodents of 6 species were trapped in Central and South America and examined for *Angiostrongylus cantonensis*. The absence of the nematode is discussed with reference to its known dispersal eastwards from East Africa to South-East Asia and some of the Pacific Islands. M.B-B.

1081—ALICATA, J. E., 1967. "Effect of freezing and boiling on the infectivity of third-stage larvae of *Angiostrongylus cantonensis* present in land snails and freshwater prawns." *J. Parasit.*, 53 (5), 1064-1066.

Specimens of *Achatina fulica* and *Macrobrachium rosenbergi*, carrying infective larvae of *Angiostrongylus cantonensis*, were exposed to 0°C. for 24 hours. The larvae were still infective when fed to rats. Larvae lost their infectivity when the snails or prawns were placed in a freezer at -15°C. for 12 or 24 hours. Some larvae recovered from snails that had been boiled in water for one minute were infective to rats, but larvae from snails boiled for 2 or 3 min. or from prawns boiled for one minute were not infective. The thermal death point of 3rd-stage larvae in water was found to be between 50 and 55°C. M.B-B.

434—ALICATA, J. E., 1968. "The gubernaculum of *Angiostrongylus cantonensis* (Chen)." *J. Parasit.*, 54 (6), 1193.

In *Angiostrongylus cantonensis* specimens cleared in glycerin (from experimentally infected rats in Hawaii), the gubernaculum can be seen to have a shape very similar to that of *A. gubernaculatus* and *A. sandarsae*. C.W.G.

863—ALICATA, J. E., 1969. "Present status of *Angiostrongylus cantonensis* infection in man and animals in the tropics." *J. trop. Med. Hyg.*, 72 (3), 53-63.

The author reviews the host and geographical distribution of *Angiostrongylus cantonensis* and its relation to cerebral angiostrongylosis in man in the Pacific and South East Asia. Human angiostrongylosis has been correlated with local eating habits. *A. cantonensis* may have originated in Madagascar and spread eastward with *Achatina fulica*. R.C.A.

2214—ALICATA, J. E., 1970. "Sources of infection and prevention of eosinophilic meningitis (cerebral angiostrongylosis)." In: Singh, K. S.; Tandan, B. K. [Editors], "H. D. Srivastava commemoration volume." Izatnagar, U.P.: Indian Veterinary Research Institute, pp. 545-554. [En] Parasitology Laboratory, Dept. of Animal Sciences, Univ. of Hawaii, Honolulu.

Geographical regions from which *Angiostrongylus cantonensis* has been recovered are listed together with the appropriate references. Sources of human infection are reviewed under the headings: molluscs, crustaceans, land planarians, mammals, fish, vegetables and fruit, water and soil. Methods of preventing infection are discussed; these mainly relate to the correct preparation of food. M.R.N.S.

819—ALICATA, J. E. & BROWN, R. W., 1962. "On the method of human infection with *Angiostrongylus cantonensis* in Tahiti." [Abstract.] *Journal of Parasitology*, 48 (2, Sect. 2), 52.
[A full account of this paper appears in *Can. J. Zool.*, 1962, 40, 755-760. For abstract see *Helm. Abs.*, 32, No. 1032.]

1032—ALICATA, J. E. & BROWN, R. W., 1962. "Observations on the method of human infection with *Angiostrongylus cantonensis* in Tahiti." *Canadian Journal of Zoology*, 40 (5), 755-760.

Alicata & Brown have investigated possible modes of human infection with *Angiostrongylus cantonensis*, the causative agent of parasitic (eosinophilic) meningoencephalitis in Hawaii and Tahiti [see abstract No. 1031 above]. Lettuce bought in the Papeete city market (Tahiti) and commonly eaten raw harboured various molluscs; these were shown by experimental infection of rats to contain infective larvae of *A. cantonensis*. The stomachs of 12 of 300 adult prawns (*Macrobrachium* sp.) collected from fresh-water streams in Tahiti also contained infective larvae. It is thought that they become infected by eating infected fresh-water lymnaeid snails and land slugs; infective larvae were recovered from *Fossaria ollula* but not from *Physa compacta*, *Tarbia granifera maiuensis* or *Melanoides newcombi* fed with the faeces of infected rats. Raw prawns and "taïoro", a food consisting of grated coconut and prawn juice, are commonly eaten by Tahitians and some local Europeans and are thought to be the main source of infection. Of 30 persons with confirmed parasitic meningoencephalitis only 2 denied having eaten raw prawns or "taïoro". The case histories are given of 12 others who apparently acquired the infection by eating raw infected prawns. There is evidence that the infective larvae of *A. cantonensis* can penetrate abraded but not intact skin of rats. J.W.S.

1446—ALICATA, J. E. & BROWN, R. W., 1962. "Preliminary observations on the use of an intradermal test for the diagnosis of eosinophilic meningoencephalitis in man caused by *Angiostrongylus cantonensis*." *Canadian Journal of Zoology*, 40 (1), 119-124.

The results of preliminary tests indicate that a negative intradermal reaction to an *Angiostrongylus* antigen is reliable in ruling out eosinophilic meningoencephalitis in man [see abstract No. 1031 above]. More information is needed on the interpretation of a positive reaction owing to the possibility of cross reaction from other helminths. J.W.S.

4844—ALICATA, J. E. & JINDRAK, K., 1970. "Angiostrongylosis in the Pacific and Southeast Asia." *Springfield, Ill.: Charles C. Thomas*, x + 105 pp.

Alicata & Jindrak describe the biology of *Angiostrongylus cantonensis* in rats, its transmission via molluscs, and its relation to eosinophilic meningoencephalitis in man. Alicata's hypothesis that *A. cantonensis* spread recently to the Pacific from Madagascar is discussed. The role of molluscs, crustaceans, planarians, vegetables and water in transmission to man is discussed along with methods of prevention and control. Clinical and pathological manifestations of angiostrongylosis are concisely summarized. There is a short section on treatment. The volume has excellent photomicrographs and a comprehensive bibliography. It is happily free of typographic errors and the English is excellent. The publishers have turned out a most attractive volume. This book will fascinate and inform physicians, comparative pathologists, parasitologists and zoologists alike. R.C.A.

2572—ALICATA, J. E., LOISON, G. & CAVALLO, A., 1963. "Parasitic meningoencephalitis experimentally produced in a monkey with larvae of *Angiostrongylus cantonensis*." *Journal of Parasitology*, 49 (1), 156-157.

A rhesus monkey died 25 days after being fed several hundred infective larvae of *Angiostrongylus cantonensis* from naturally infected slugs, *Vaginulus plebeius*, collected in New Caledonia. Examination of the monkey's blood, cerebrospinal fluid and brain revealed eosinophilic meningoencephalitis. Young adult worms were found in the brain. The cause of death is thought to have been an acute bilateral pneumonia involving the pleura. J.W.S.

141—ALICATA, J. E. & MCCARTHY, D. D., 1964. "On the incidence and distribution of the rat lungworm *Angiostrongylus cantonensis* in the Cook Islands, with observations made in New Zealand and Western Samoa." *Canadian Journal of Zoology*, 42 (4), 605-611.

In view of the recognition of the role of *Angiostrongylus cantonensis* in the aetiology of eosinophilic meningoencephalitis in the Pacific, the authors conducted a survey on the island of Rarotonga to determine the distribution of the nematode in rats, molluscs and other hosts. The results are given together with a report on a search for lungworms in rats trapped in Auckland, New Zealand and in Apia, Western Samoa; 85% of the 240 rats examined on Rarotonga were infected, but none was found in 156 rats from the 2 other localities. The slugs *Deroceras laeve* and *Vaginulus plebeius* and the snails *Bradybaena similaris* and *Subulina octona* were infected with the larvae of *A. cantonensis* on Rarotonga. Of the 25 unidentified land planarians, 60 fresh-water prawns (*Macrobrachium* sp.), 50 sea-slugs (*Stylocheilus longicaudus*), 38 fresh-water fish (*Tilapia* sp.) and 44 mud-fishes examined on Rarotonga, a few larvae of *A. cantonensis* were found in only 3 planarians and 2 prawns. The molluscs examined in the 2 other localities revealed no *A. cantonensis* larvae. Rats and molluscs on Rarotonga are a high potential source of human infection with the nematode. The method of human infection on the island has yet to be ascertained. H.H.W.

2564—ALICATA, J. E. & NISHIMURA, K., 1965. "On the presence of *Angiostrongylus cantonensis* among wild rats in Okinawa." *J. Parasit.*, 51 (5), 822.

4 of 12 *Rattus* sp. examined were infected with *Angiostrongylus cantonensis*. This is the northernmost record of the parasite which is believed to have been introduced to Micronesia with *Achatina fulica*. T.Y.

1265—ANDERSON, R. I., SADUN, E. H., ROSEN, L., WEINSTEIN, P. P. & SAWYER, T., 1962. "The detection of antibodies in eosinophilic meningitis." [Abstract.] *Journal of Parasitology*, 48 (2, Sect. 2), 15-16.

Eosinophilic meningitis of unknown aetiology has been reported in Tahiti. *Angiostrongylus cantonensis* was recovered from one patient with this condition. Samples of cerebrospinal fluid from 9 patients with the condition already diagnosed, and from other adults and children, were tested by complement fixation against metabolic and somatic antigens of *A. cantonensis* and other nematodes. Many non-specific reactions occurred although the diagnosed cases gave positive reactions with *A. cantonensis* metabolic antigens. In spite of these reactions it is considered that too little is known of the condition to suggest a helminthic aetiology. W.A.G.C.

- *2632—ARAMBULO, III, P. V. & YOGORE, Jr., M. G., 1966. "On the isolation of rat lungworm larvae from the giant African snail in the Philippines." *Acta med. philipp.*, 3 (3), 56-57.
- 3555—ASH, L. R., 1967. "Observations on the role of molluscs and other invertebrates in the transmission of *Angiostrongylus cantonensis* infection to man in New Caledonia." Seminar on Helminthiases and Eosinophilic Meningitis, Noumea, New Caledonia, June 5-16, 1967. *Noumea: South Pacific Commission. Working Paper No. 13*, 9 pp.
- Examinations of market gardens producing green vegetables around Noumea, New Caledonia, for intermediate hosts of *Angiostrongylus cantonensis* are reported. *Laevicaulus alte*, *Angustipes plebeius*, *Deroceras laeve*, *Bradybaena similis*, *Helix aspersa* and a planarian (probably *Geoplana forsterorum*) were commonly infected with the 3rd-stage larvae of *Angiostrongylus cantonensis*. *L. alte* and *Angustipes plebeius* were most frequently infected and probably serve as the chief source of infection for rats. The high level of infection in these slugs, and hence in the rat population, leads to extensive contamination of the ground enabling other molluscs to acquire the infection. There was no apparent seasonal difference in the rate and level of infection in the slugs. It is suggested that planarians are the single most important source of human infection in New Caledonia. They show a marked seasonal occurrence, reaching their peak during the cooler months of the year (July to September), which corresponds with the peak growing season of green vegetables and probably results in the peak occurrence of human eosinophilic meningitis in September and October. In addition, the small size of these planarians, their ability to fragment easily, and their high incidence of infection makes them ideal vectors of *Angiostrongylus cantonensis* infection in man. P.S.G.
- 226—ASH, L. R., 1968. "The occurrence of *Angiostrongylus cantonensis* in frogs of New Caledonia with observations on paratenic hosts of metastrongyles." *J. Parasit.*, 54 (3), 432-436.
- 23 of 43 frogs (*Hyla aurea*) from market gardens in Noumea, New Caledonia, were found to harbour infective-stage larvae of *Angiostrongylus cantonensis* in their tissues. The larvae were encapsulated in the wall of the alimentary tract, mesentery, liver and somatic musculature; they were infective for rats. Sea snakes (*Laticauda colubrina*) were experimentally infected with 3rd-stage *A. cantonensis* larvae and, in these hosts, the larvae survived and remained infective for rats for at least one month. The use of paratenic hosts by *A. cantonensis* and other metastrongyles is discussed. [A.S.] M.R.N.S.
- 2563—AUBRY, P. & BARBOTIN, M., 1967. "Paralysie faciale périphérique et méningite à éosinophiles. Intérêt diagnostique des ponctions lombaires répétées." *Bull. Soc. Path. exot.*, 60 (5), 457-460. [English summary pp. 459-460.]
- 678—BEAVER, P. C. & ROSEN, L., 1964. "Memorandum on the first report of *Angiostrongylus* in man, by Nomura and Lin, 1945." *American Journal of Tropical Medicine and Hygiene*, 13 (4), 589-590.
- The first discovery of *Angiostrongylus cantonensis* in man was made in 1945 by Nomura and Lin (See *Taiwan No Ikai*, 3, 589-592). In view of recent interest in the subject and the difficulty of obtaining the original report, Beaver & Rosen give the case report section of the article. J.H.B.
- 439—BHAIBULAYA, M., 1968. "A new species of *Angiostrongylus* in an Australian rat, *Rattus fuscipes*." *Parasitology*, 58 (4), 789-799.
- Angiostrongylus mackerrasae* n.sp. was found in the pulmonary arteries and right ventricle of *Rattus fuscipes* (type host) from the rain forest of Mount Glorious, Queensland, Australia. Mixed infections of *A. mackerrasae* and *A. cantonensis* were found in *R. norvegicus* from Brisbane; the latter was much more numerous in these rats. The new species was not found in *R. rattus* in Brisbane or in *Melomys cervinipes* from Rathdowney and Mount Glorious. Spicules of *A. mackerrasae* n.sp. are less than half as long as those of *A. cantonensis*, the postero-lateral ray is usually the same length or longer than the medio-dorsal ray, and the posterior end of the female ends in a minute projection. The new species is also differentiated from other members of the genus by its size, form of the female tail, bursa characteristics, and position of the vulva and phasmids. R.C.A.
- 1692—BISSERU, B., 1969. "The effect of suppressive therapy on immunity in laboratory rats and a monkey infected with *Angiostrongylus cantonensis* (Malayan strain)." *Proceedings of seminar on filariasis and immunology of parasitic infections and laboratory meeting, Singapore*, 1968, pp. 115-124.
- Twelve albino rats were infected with 2 doses of 10 to 600 infective larvae of *Angiostrongylus cantonensis*. Results based on eosinophil counts showed that rats given only 10 larvae were resistant to a second infection. Rats given 600 larvae lost weight and were subject to stress. Prednisolone, an immunosuppressive drug, reduced eosinophilia to almost negative levels and lowered resistance to infection. Butazolidin, an anti-rheumatic agent, had no effect on the infection in the rat. Thiabendazole did not control infection in a rat after the larvae had undergone final moults in the brain. 12,000 infective *A. cantonensis* larvae failed to infect a monkey, *Macaca irus*. K.H.
- 1738—BISSERU, B., 1970. "Comparison of the rat lungworm, *Angiostrongylus cantonensis* ('eosinophilic meningoencephalitis') throughout the States of Malaya." [Abstract.] *J. Parasit.*, 56 (4, Sect. 2), (Int. Congr. Parasit. (2nd), Washington, D.C., Sept. 6-12, 1970, Proceedings, Part I), pp. 30-31.
- 1766—BISSERU, B., LIM KEE CHONG & POOPALACHELVAM, M., 1969. "Observations on the brains of laboratory rats infected with *Angiostrongylus cantonensis*." [Demonstration.] *Proceedings of seminar on filariasis and immunology of parasitic infections and laboratory meeting, Singapore*, 1968, p. 235.
- 2264—BISSERU, B. & PERIANAN, A., 1969. "*Angiostrongylus cantonensis* (rat lungworm) infection in laboratory-bred snails." [Demonstration.] *Proceedings of seminar on filariasis and immunology of parasitic infections and laboratory meeting, Singapore*, 1968, pp. 236-238.
- 3298—BISSERU, B. & VERGHESE, T., 1970. "Natural infection of the land mollusc *Achatina fulica* with *Angiostrongylus cantonensis* in Malaya." [Demonstration.] *SEast Asian J. trop. Med. publ. Hlth*, 1 (2), 294-295.

- 3561—BRUMPT, V. ET AL., 1968. "Incidence d'*Angiostrongylus cantonensis* (Chen) au Cambodge." *Bull. Soc. Path. exot.*, 61 (3), 444-462. [English summary pp. 458-459.]
- Larvae similar to the infective stage of *Angiostrongylus cantonensis* were found in 7 species of gastropods in Cambodia. However, only larvae from *Achatina fulica* developed in white rats and proved to be *Angiostrongylus cantonensis*. *A. cantonensis* adults were found in *Rattus norvegicus*, a subspecies of *R. rattus*, and *Bandicota indica nemorivaga*; 20% of *R. norvegicus* from Phnom-Penh were infected. Eosinophilic meningoencephalitis is rather rare in Cambodia, possibly because the inhabitants only consume cooked molluscs. The authors describe, however, 2 cases in children with many of the signs and symptoms of angiostrongyliasis. The children were from the same family and infected *Achatina fulica* were found in the family garden. R.C.A.
- 202—BRYGOO, E. R. & CHABAUD, A. G., 1964. "Présence d'*Angiostrongylus cantonensis* (Chen) à Madagascar." *Annls Parasit. hum. comp.*, 39 (6), 793.
- Nippostrongylus brasiliensis*, *Aspiculuris tetraptera*, *Heterakis spumosa*, *Mastophorus muris* and *Angiostrongylus cantonensis* were found in *Rattus rattus* from Madagascar. R.C.A.
- 2724—CHANG, P. K., CROSS, J. H. & CHEN, S. S. S., 1968. "Aquatic snails as intermediate hosts for *Angiostrongylus cantonensis* on Taiwan." *J. Parasit.*, 54 (1), 182-183.
- Cipangopaludina chinensis* has been confirmed as a natural intermediate host of *Angiostrongylus cantonensis* in Taiwan. 3 other freshwater snails, *Sinotaia quadrata*, *Lymnaea stuebeli* and *Segmentina hemisphaerula*, were successfully infected with *A. cantonensis* in the laboratory. P.S.G.
- 2955—CHAR, D. F. B. & ROSEN, L., 1967. "Eosinophilic meningitis among children in Hawaii." *J. Pediatr.*, 70 (1), 28-35.
- Five cases of meningitis characterized by a pleocytosis consisting in part of eosinophils are described in children from 11 months to 14 years old from Hawaii. Epidemiological evidence suggests that *Angiostrongylus cantonensis* was the pathogen. Present knowledge of the life-cycle and epidemiology of this nematode are reviewed. Other causes of eosinophilic meningitis are also considered. P.S.G.
- 5040—CHENG, T. C., 1966. "Perivascular leucocytosis and other types of cellular reactions in the oyster *Crassostrea virginica* experimentally infected with the nematode *Angiostrongylus cantonensis*." *J. Invert. Path.*, 8 (1), 52-58.
- Ten *Crassostrea virginica* were exposed to about 4,000 first-stage larvae of *Angiostrongylus cantonensis*. After 23 hours and 3 days larvae were found in the stomachs and blood vessels. On the 10th and 14th days after exposure large aggregates of leucocytes were observed around the periphery of blood vessels and sinuses forming compact capsules. In all the oysters, larvae were found in the body tissues, especially in Leydig tissue. C.W.G.
- 2508—CHENG, T. C., 1970. "Parasites transmittable through waste water to estuarine invertebrates of economic importance, and their public health significance." [Abstract.] *J. Parasit.*, 56 (4, Sect. 2), (Int. Congr. Parasit. (2nd), Washington, D.C., Sept. 6-12, 1970, Proceedings, Part I), pp. 54-55.
- 462—CHENG, T. C. & ALICATA, J. E., 1964. "Possible role of water in the transmission of *Angiostrongylus cantonensis* (Nematoda: Metastrongylidae)." [Abstract.] *J. Parasit.*, 50 (3, Sect. 2), 39-40.
- 638—CHENG, T. C. & BURTON, R. W., 1965. "The American oyster and clam as experimental intermediate hosts of *Angiostrongylus cantonensis*." *J. Parasit.*, 51 (2), 296.
- Although *Angiostrongylus cantonensis* has not been reported from North America, experiments are described to determine whether North American edible molluscs could serve as intermediate hosts and thus act as potential vehicles for infection. The shellfish selected were *Crassostrea virginica* and *Mercenaria mercenaria*. 1st-stage larvae of the nematode were introduced into the trays containing shellfish; viable 2nd-stage and 3rd-stage larvae were recovered from all the molluscs exposed. The 3rd-stage larvae were used successfully to infect young white rats. M.B.-B.
- 350—CHENG, T. C.; RIFKIN, E., 1970. "Cellular reactions in marine molluscs in response to helminth parasitism." In: Snieszko, S. F. [Editor], "A symposium on diseases of fishes and shellfishes." *Spec. Publ. Am. Fish. Soc.*, No. 5, pp. 443-496.
- The authors cite 220 references in a comprehensive review of the morphology, chemistry and function of the different cell and tissue types in molluscs (particularly marine species) involved in cellular reactions to helminth parasites, illustrated by numerous line drawings, photomicrographs and electronmicrographs. The reactive elements include various types of blood and connective tissue cells and fibres, 3 types of myofibres, and so-called brown cells. The functional morphology of leucocytes, fibroblast-like cells, intercellular fibres and brown cells in *Crassostrea virginica*, and haemopoiesis and ontogenesis are reviewed. Cellular reactions include phagocytosis, leucocytosis, necrocytosis and, of major importance, encapsulation. It is tentatively concluded that asexually reproducing stages of larval digenans do not become encapsulated in natural molluscan hosts, although slight encapsulation may occur if the larvae become moribund or lodge in abnormal sites. Metacercariae usually elicit encapsulation. The reaction stimulus usually appears to be some material of parasite origin, commonly an inner cyst wall. The available information on larval cestodes in marine molluscs indicates that encapsulation usually occurs, especially in unnatural hosts. The ultrastructure of the capsule surrounding *Tylocephalum* metacercariae in *C. virginica* and the encapsulation complex surrounding *Angiostrongylus cantonensis* 3rd-stage larvae in *Achatina fulica* are described. A classification of encapsulation complexes in molluscs into antiquifibrous, novufibrous, fibroblastic, leucocytic and myofibrous types is proposed. J.W.S.
- 2845—COURDURIER, J., DELGADO Y GARNICA, R., LÓPEZ FERNÁNDEZ, J. R. & GUILHON, J. C., 1966. "Étude des variations de l'éosinophilie sanguine chez le rat infesté expérimentalement par *Angiostrongylus cantonensis*." *Bull. Soc. Path. exot.*, 59 (3), 359-365.
- Wistar rats were infected orally with 90 larvae of *Angiostrongylus cantonensis*. The eosinophil counts were estimated, before and after infection, per 100 leucocytes and per 100 granulocytes. Two increases in the eosinophil count occur; one, from day 0 to day 28 reaching a peak at about day 6, is thought to coincide with the intestinal, blood and cerebral phases of the life-cycle, the second, greater, increase occurs from day 28 to day 70 and reaches a peak on or about day 46; it is probably due to the pulmonary phase of the cycle and coincident with the appearance of larvae in the faeces. K.H.

2296—COURDURIER, J., GUILLON, J. C. & MALARDÉ, L., 1967. "Réalisation du cycle d'*Angiostrongylus cantonensis* (Chen) au laboratoire. II. Utilisation d'*Australorbis glabratus* (Say) comme hôte intermédiaire. Contribution à l'étude du mode d'infestation du mollusque par les larves du parasite. Aspects histologiques." *Bull. Soc. Path. exot.*, 60 (2), 165-173. [English summary p. 172.]

The life-cycle of *Angiostrongylus cantonensis* was demonstrated experimentally using *Australorbis glabratus*, and the white rat. The mode of entry into the planorbid, duration of the infection and tissue reactions of each stage were examined histologically. There appears to be a tolerance on the part of the host to the parasite as neither true inflammatory reaction nor necrosis were observed. *Angiostrongylus cantonensis* showed a marked tropism for mesenchymatous tissue. K.H.

3410—COURDURIER, J., GUILLON, J. C. & MALARDE, L., 1968. "Réalisation du cycle d'*Angiostrongylus cantonensis* (Chen) au laboratoire. III. Les lésions chroniques des poumons chez les rats infestés expérimentalement." *Bull. Soc. path. exot.*, 61 (2), 254-258. [Discussion pp. 258-259.]

The authors describe the lesions produced in the pulmonary arteries and lungs of rats by the presence of *Angiostrongylus cantonensis*. In recent and old infections adult worms elicited progressive hypertrophy of the muscular wall of the arteries and also a slight hyperplasia of the endothelium. By 18 months some worms had died and these elicited a considerable inflammation and macrophage activity in the arteries. In recent infections eggs were deposited in regular masses in the lung parenchyma; eggs became surrounded by fibrocytes. Parts of the lungs free of eggs were emphysemic and peribronchial, and perivascular infiltrations of lymphocytes appeared; infarcts were also noted. By the 13th month much of the lung was fibrosed although eggs were still numerous and larvae could be found in bronchioles. By the 18th month, eggs were rare and isolated in fibrosed areas. Larvae were not found in bronchioles. The authors suggest that the failure of rats to pass larvae in long-standing infections is the result of pulmonary fibrosis which prevents larvae from being released. In a discussion Guillon comments on *A. vasorum* of the dog. He claims that *A. cantonensis* can mature in the dog and that dogs infected overseas could introduce this helminth into Europe. R.C.A.

1615—COURDURIER, J. ET AL., 1964. "Réalisation du cycle d'*Angiostrongylus cantonensis* au laboratoire. Observations sur ce cycle et l'anatomopathologie causée par ce parasite chez divers animaux de laboratoire." *Bull. Soc. Path. exot.*, 57 (6), 1255-1262. [English summary pp. 1261-1262.]

The authors repeated earlier Australian [see Helm. Abs., 24, No. 10a] work on the life-cycle of *Angiostrongylus cantonensis* using slugs from New Caledonia and laboratory white rats, mice and rabbits. The parasite failed to leave the brain of mice and rabbits. Infected mice did not show neurologic signs. The authors were unable to infect *Arion rufus* from France with *Angiostrongylus cantonensis*. R.C.A.

2256—CROOK, J. R., FULTON, S. E. & SUPANWONG, K., 1968. "Ecological studies on the intermediate and definitive hosts of *Angiostrongylus cantonensis* (Chen, 1935) in Thailand." *Ann. trop. Med. Parasit.*, 62 (1), 27-44.

Rats and associated gastropods, as definitive and intermediate hosts respectively of *Angiostrongylus cantonensis*, were collected and examined for infections throughout Thailand. The infection rates of the rats averaged less than 10% but showed wide local and seasonal variations. The most susceptible species appeared to be *Bandicota indica* with a maximum infection rate of 66.7% in the Chiang Mai upland region of the north area during the cold season. In the savanna region of the south-east area, rats of 4 species and gastropods of 5 species were all negative. The over-all infection rate of gastropods was less than 2%. The most important species as an intermediate host was usually *Achatina fulica* although other species, such as *Sarika resplendens* in the north-east, were more important locally. *Hemiplecta siamensis*, found to be infected in the north and west areas, is a new host for *Angiostrongylus cantonensis*. M.R.N.S.

2307—CROOK, J. R.; FULTON, S. E.; SUPANWONG, K., 1971. "The infectivity of third stage *Angiostrongylus cantonensis* larvae shed from drowned *Achatina fulica* snails and the effect of chemical agents on infectivity." *Trans. R. Soc. trop. Med. Hyg.*, 65 (5), 602-605. [En] Dept. of Parasitology, Medical Research Laboratory, SEATO Medical Project, Rajavithi Road, Bangkok, Thailand.

In Thailand, a study was made to determine water contamination by larvae of *Angiostrongylus cantonensis* released from drowned *Achatina fulica*. Of 30 *A. fulica* drowned in dechlorinated water, 18 were infected and larvae were found in the water and in the digestion sediment of snails removed from the water after 60 hours. Larvae from water and digestion sediments were fed to white rats. In all cases, the former infected the rats; some larvae digested from snail tissues after 60 hours in the water were infective. The effect of water purification chemicals on shed infective larvae was studied. Free residual chlorine at 1.0 p.p.m. had no effect on larvae either shed or digested from snail tissues. Numerous living larvae were recovered from water treated with 16 mg. of iodine per quart for 30 min. Using these larvae, 4 of 7 experimental infections of rats were successful but most larvae were rendered uninfactive by the iodine. A.J.

3567—CROSS, J. H., 1967. "Review of angiostrongyliasis in Taiwan." Seminar on Helminthiases and Eosinophilic Meningitis, Noumea, New Caledonia, June 5-16, 1967. Noumea: South Pacific Commission. Working Paper No. 5, 7 pp.

Case histories of 12 patients from Taiwan, who showed symptoms of eosinophilic meningitis and who had either ingested snails or had angiostrongylids in their cerebro-spinal fluid, are reported. Epidemiological studies of *Angiostrongylus cantonensis* have shown *Bandicota indica nemorivaga*, *Rattus coxinga coxinga*, *R. losea*, *R. norvegicus*, *R. rattus mindanensis*, *R. rattus* and *Herpestes urva* (experimentally) to be definitive hosts and *Achatina fulica*, *Bradybaena similaris*, *Vaginalus plebeius*, *Cipangopaludina chinensis*, *Planaria* sp., *Sinotaia quadrata* and *Lymnaea swinhoe* (the last 2 experimentally) to be intermediate hosts. P.S.G.

1571—CROSS, J. H., CHEN, S. S. S. & LU, S. K., 1970. "Further studies on the development of *Angiostrongylus cantonensis* in the Formosan mongoose." *J. Parasit.*, 56 (4), 838-839.

Sixteen *Herpestes urva* in Taiwan were each experimentally infected with 2,000 3rd-stage larvae of *Angiostrongylus cantonensis*. At autopsy 7 to 44 days later there was no evidence of infection and it is concluded that this mongoose is refractory to infection. A previous report of the development of *A. cantonensis* in *H. urva* [see *Helminth. Abstr.*, 35, No. 2494] is assumed to be a case of misidentification. M.R.N.S.

2690—DESCHIEENS, R. & COURDURIER, J., 1966. "Commentaires relatifs à la méningite à éosinophiles angiostrongylienne." *Bull. Soc. Path. exot.*, 59 (3), 349-359.

The literature on the eosinophilic meningitis found in human infections of *Angiostrongylus cantonensis* is reviewed. The geographical distribution of infection, clinical symptoms and the risk of the spread of the disease by rats are discussed. In man the parasite is spontaneously eliminated within a few months. Treatment of the inflammatory conditions is by corticosteroids. K.H.

48—Proceedings of the Helminthological Society of Washington.

- d. DOUGHERTY, E. C., 1946.—"The genus *Aelurostrongylus* Cameron, 1927 (Nematoda: Metastrongylidae), and its relatives; with descriptions of *Parafilaroides*, gen. nov., and *Angiostrongylus gubernaculatus*, sp. nov." 13 (1), 16-25.

(48d) Dougherty has recently reviewed *Filaroides* and *Metathelazia* of the Filaroidinae [see *Helminth. Abs.*, Vol. XII, No. 102a]. He now gives a brief key to the 6 genera of that subfamily and lists the species and type hosts of the other 4 genera: *Parafilaroides* n.g. (for *Pseudalius gymmurus*), *Aelurostrongylus*, *Angiostrongylus*, and *Gurltia*. *Angiostrongylus gubernaculatus* n.sp., from the heart of *Taxidea taxus* and *Mephitis mephitis*, is described and figured. B.G.P.

1323—DROZDZ, J.; DOBY, J. M., 1971. [Study of the migration of *Angiostrongylus* (*Parastrongylus*) *dujardini* Drozd & Doby, 1970 and of *A. (P.) cantonensis* (Chen, 1935) (Nematoda: Metastrongyloidea) in the body of the field mouse, *Apodemus sylvaticus* (L. 1758).] "Etude comparée des migrations d'*Angiostrongylus* (*Parastrongylus*) *dujardini* Drozd et Doby, 1970 et d'*A. (P.) cantonensis* (Chen, 1935) (Nematoda: Metastrongyloidea) dans l'organisme du mulot, *Apodemus sylvaticus* (L. 1758)." *C. r. Séanc. Soc. Biol.*, 165 (2), 417-420.

Apodemus sylvaticus were fed *Biomphalaria glabrata* infected with either *Angiostrongylus dujardini* or *A. cantonensis* and were killed one, 4, 24, 28, 32, 48 and 72 hours, and 7 and 12 days after the infective feed. More than 4,100 larvae and young adults were recovered; the mean per animal was about 100 but the range was from 22 to 442 for *A. dujardini* and 22 to 2,489 for *A. cantonensis*. The localization in the different organs was studied. *A. dujardini* migrated more slowly than did *A. cantonensis* but developed more rapidly. The first larvae of *A. cantonensis* reached the lungs in one hour; those of *A. dujardini* took 28 hours to get to the lungs but then remained in the pulmonary arteries and heart until they reached maturity, becoming 4th-stage larvae by 72 hours and young adults by the 7th day. Larvae of *A. cantonensis* continued to migrate and at 28 hours 95% were in the central nervous system (35% in the brain and cerebellum and 60% in the spinal cord); 4th-stage larvae were not found until 3 to 7 days and young adults were not found until between the 7th and 12th days. All the field-mice infected with *A. cantonensis* died within 12 to 14 days; it was, therefore, impossible to determine if this species would mature in the field-mouse. S.W.

1159—CUCKLER, A. C., EGERTON, J. R. ALICATA, J. E., 1965. "Therapeutic effect thiabendazole on *Angiostrongylus cantonensis* infections in rats." *J. Parasit.*, 51 (3), 392-393.

Thiabendazole proved effective in controlling early invasive stages of *Angiostrongylus cantonensis* in experimentally infected rats. Depending on dosage, time and duration of medication the worms were sterilized, their migration delayed or they were killed. A diet containing 0.1% thiabendazole fed to exposed rats for 7, 14 or 21 days provided almost complete cure. The parasites became refractory during the 3rd week and then susceptible again when 4-6 weeks old. The use of thiabendazole for possible therapy of parasitic meningoencephalitis in man is suggested. G.D.S.

3570—DESCHIEENS, R. & COURDURIER, J., 1967. "Notes on eosinophilic meningitis due to *Angiostrongylus*." Seminar on Helminthiasis and Eosinophilic Meningitis, Noumea, New Caledonia, June 5-16, 1967. Noumea: South Pacific Commission. Working Paper No. 15, 9 pp.

857—DUNSMORE, J. D., 1968. "Absence of *Angiostrongylus cantonensis* from the Gulf of Carpentaria in northern Australia." *J. Parasit.*, 54 (4), 826.

A survey of some 200 rodents and small marsupials from the Sir Edward Pellew Islands, Gulf of Carpentaria, Australia, failed to demonstrate the presence of *Angiostrongylus cantonensis*. This is considered to be due to the absence of *Achatina fulica*, the most likely intermediate host, from Australia. P.S.G.

2967—FLOCH, H. A., COURDURIER, J. & JACOBI, J. C., 1966. "Contribution à l'étude de la répartition géographique d'*Angiostrongylus cantonensis*." *Bull. Soc. Path. exot.*, 59 (3), 365-371.

No evidence of the occurrence of *Angiostrongylus cantonensis* in the area about Cayenne in French Guiana was obtained from the examination of 106 rats collected from local habitations and 1,418 molluscs. 2 susceptible intermediate hosts, *Subulina octona* and *Australorbis glabratus*, were present. K.H.

1062—FLOCH, H. A., COURDURIER, J. & JACOBI, J. C., 1966. "Sur la méningite à éosinophiles du Pacifique-Sud. Recherches en Guyane française." *Arch. Inst. Pasteur Guyane fr.*, XXVIe Année, No. 512, 5 pp.

In French Guiana rats and molluscs (terrestrial and aquatic) were examined for larvae of *Angiostrongylus cantonensis*. Although nematode larvae were found in *Subulina octona* and *Veronicella linguiformis* they did not produce *A. cantonensis* infection in rats. In 20 people negative intradermal reactions with *A. cantonensis* antigen were observed. K.H.

- 1923—GALLIARD, H., 1962. "Le syndrome tropical de méningo-encéphalite avec l'éosinophilie rachidienne." *Bulletin de la Société de Pathologie Exotique*, 55 (4), 731-733.
Galliard discusses eosinophilic meningitis in man and reviews the evidence that *Angiostrongylus cantonensis* is responsible. Some reservations are made in that the slightness of this syndrome and the fact that it becomes cured spontaneously is not in agreement with the localization of a worm in the central nervous system and the gravity of the lesions observed in the one case known to have been caused by *A. cantonensis*. Other possible causes are mentioned. S.W.
- 2299—GUILHON, J., 1965. "Transmission d'*Angiostrongylus cantonensis* (Chen, 1935) au chien." *C.r. hebdomadaire. Séances Acad. Sci., Paris*, 261 (4), 1089-1091.
1st-stage larvae of *Angiostrongylus cantonensis* appeared in the faeces of 2 young dogs 51 days after feeding them with 3rd-stage larvae in chopped infected *Australorbis glabratus*. D.W.L.
- 3577—GUILHON, J., 1967. "Angiostrongylin nematodes and human eosinophilic meningitis." Seminar on Helminthiases and Eosinophilic Meningitis, Noumea, New Caledonia, June 5-16, 1967. *Noumea: South Pacific Commission. Working Paper No. 4*, 5 pp.
- 5071—GUILHON, J. & GAALON, A. DE, 1966. "Éosinophilie sanguine et infestation expérimentale du chien par *Angiostrongylus vasorum* (Baillet, 1866) et par *Angiostrongylus cantonensis* (Chen, 1935)." *C.r. hebdomadaire. Séances Acad. Sci., Paris, Série D*, 262 (8), 894-896.
The eosinophilia of 3 dogs experimentally infected with larvae of *Angiostrongylus vasorum* was more intense (26 to 63%) and prolonged than that of 3 dogs experimentally infected with larvae of *A. cantonensis* (13 to 26% eosinophilia). C.W.G.
- 2063—GUILHON, J., MISHRA, G. S. & BÉNEX, J., 1970. "Étude de la réaction d'hypersensibilité cutanée (I.D.R.) au cours d'infestations expérimentales à '*Angiostrongylus cantonensis*' et à '*Angiostrongylus vasorum*'." *Bull. Soc. Path. exot.*, 63 (3), 367-376. [English summary p. 375.]
Ten dogs experimentally infected with *Angiostrongylus cantonensis* and 16 infected with *A. vasorum* were skin tested with an antigen prepared from *A. cantonensis* adults. The preparation and chemical analysis of the antigen are described. In *A. cantonensis*-infected dogs the skin reaction appeared within 40 min. of injection, formed an erythremous plaque 1.5 to 3 cm. in diameter, and persisted for up to 58 days. Skin test was positive 5 days before larvae appeared in the faeces. In *A. vasorum*-infected dogs the reaction (1 to 2 cm.) began one hour after injection but faded within 3 to 5 hours. Animals with infections of more than 48 days duration showed no reaction. P.S.G.
- 1878—HEYNEMAN, D. & LIM BOO LIAT, 1965. "Prolonged survival in rats immunized by a small number of low-level doses of *Angiostrongylus cantonensis* and challenged with a lethal level of infective larvae." [Demonstration.] *Med. J. Malaya*, 20 (2), 162-163.
- 1468—HEYNEMAN, D. & LIM, B. L., 1966. "Comparative susceptibility of primitive and higher primates to infection with *Angiostrongylus cantonensis* (Nematoda: Metastrongylidae)." [Demonstration.] *Med. J. Malaya*, 20 (4), 341-342.
- 1977—HEYNEMAN, D. & LIM, B. L., 1966. "Comparison of developmental rates of two strains of *Angiostrongylus cantonensis* in the same laboratory-bred final hosts." [Demonstration.] *Med. J. Malaya*, 20 (4), 343-344.
- 2919—HEYNEMAN, D. & LIM, B. L., 1967. "Lack of cross-infection immunity as evidence for biological specificity among three geographical strains of *Angiostrongylus cantonensis* (Nematoda: Metastrongylidae)." [Demonstration.] *Med. J. Malaya*, 21 (4), 375.
- 2582—HEYNEMAN, D. & LIM, B. L., 1967. "Discovery of a new mode of transmission of *Angiostrongylus cantonensis* in Malaya." [Demonstration.] *Med. J. Malaya*, 21 (4), 377.
- 3579—HEYNEMAN, D. & LIM, B. L., 1967. "*Angiostrongylus cantonensis*: proof of direction transmission with its epidemiological implication." *Science, N.Y.*, 158 (3804), 1057-1058.
Infective larvae of *Angiostrongylus cantonensis* are shed in the mucus exuded by the Malayan slugs *Microparmarion malayanus*. These larvae were recovered from lettuce leaves and produced normal infections in white rats. Lettuce sold in the public market yielded small numbers of larvae. It is suggested that the local population, exposed to repeated low-level infection, may become immune to the rare massive exposure and clinical disease that could result from ingestion of heavily infected raw slugs. [A.S.] P.S.G.
- 3580—HEYNEMAN, D. & LIM, B. L., 1967. "A summary of recent studies on *Angiostrongylus cantonensis* host-parasite relations in Malaysia." Seminar on Helminthiases and Eosinophilic Meningitis, Noumea, New Caledonia, June 5-16, 1967. *Noumea: South Pacific Commission. Working Paper No. 1*, 7 pp.
- 3790—HORI, E., MIYAMOTO, K., IKEDA, O., ABE, H. & NAKASAWA, H., 1969. [A survey of parasitic helminths, especially *Angiostrongylus cantonensis* (Chen, 1935) Dougherty, 1946 from house rodents in the harbour side areas and overseas ships of Yokohama and Kawasaki.] *Jap. J. Parasit.*, 18 (3), 258-264. [In Japanese: English summary p. 264.]
A survey was made of helminth infections of rodents in harbour areas or on ships at Yokohama and Kawasaki, Japan. 3 of 164 *Rattus norvegicus* from the harbour area had *Angiostrongylus cantonensis* infections. No infections of *A. cantonensis* were found amongst 105 rodents (*R. norvegicus*, *R. rattus* and *Mus musculus*) collected from the ships. Other parasites found were *Nippostrongylus brasiliensis*, *Strongyloides ratti*, *Capillaria hepatica*, *Trichuris muris*, *Syphacia* sp., *Cysticercus fasciolaris*, *Hymenolepis diminuta*, *H. nana* and *Moniliformis* sp. [From English summary.] K.H.
- 2016—HORIO, S. R. & ALICATA, J. E., 1961. "Parasitic meningo-encephalitis in Hawaii. A new parasitic disease of man." *Hawaii med. J. inter-Is. Nurs. Bull.*, 21 (2), 139-140.
A case of parasitic meningoencephalitis caused by *Angiostrongylus cantonensis* migrating through the brain is described. This represents the first clinically diagnosed case of a newly recognized illness of man in Hawaii. Infection resulted from eating raw *Veronicella leydigii* from an area in Honolulu where the slugs were found naturally infected with *A. cantonensis*. Artificial digestion of 10 slugs yielded several hundred infective larvae which produced brain infections when fed to laboratory rats. Diagnosis was based on neurologic and non-specific symptoms, presence of eosinophils in the spinal fluid and a positive skin reaction to *A. cantonensis* antigen. It is suggested that this disease may be identical with "eosinophilic meningitis" in Tahiti, reported by Rosen *et al.* [see *Helm. Abs.*, 32, No. 1062]. S.W.

229—JACOBS, L., LUNDE, M. N. & WEINSTEIN, P. P., 1965. "Hemagglutination test results with antigens derived from cultures of *Angiostrongylus cantonensis* and with whole worm extracts." [Abstract.] *J. Parasit.*, 51 (2, Sect. 2), 38.

*65—JENNY, B.; BIOT, J.; FOUQUET, M.; THOMAS, J.; MAFART, Y., 1969. [Eosinophilic meningitis. A study of 62 cases in Tahiti, 51 of whom were expatriates.] "La méningite à éosinophiles. Étude de 62 cas, dont 51 chez des sujets transplantés à Tahiti." *Méd. trop.*, 29 (3), 330-340.

821—JINDRÁK, K., 1968. "Early migration and pathogenicity of *Angiostrongylus cantonensis* in laboratory rats." *Ann. trop. Med. Parasit.*, 62 (4), 506-517.

When 1,000 to 5,000 3rd-stage infective *Angiostrongylus cantonensis* larvae were fed to albino rats, most larvae entered the stomach wall via the portal circulation and reached the liver within 2 hours. After 4 hours they reached the lungs, a small number of larvae migrating via the lymphatics. During the first day of infection larvae were found mainly in the lungs and muscles, during the 2nd and 3rd days they accumulated in the brain and on the 4th day were found only in the central nervous system. The pathological damage associated with the larval migration is briefly described. C.W.G.

2240—JINDRÁK, K., 1968. "The pathology of radicular involvement in angiostrongylosis as observed in experimentally infected calves and pigs." *Virchows Arch. path. Anat. Physiol., Abt. A*, 345 (3), 228-237. [German summary p. 228.]

Angiostrongylus cantonensis larvae were administered orally to 5 calves and 5 pigs at doses of 70,000 and 20,000 larvae each, respectively. The animals were autopsied 3, 7, 14, 28 and 56 days after infection. All 5 calves and one pig showed cerebral involvement. 3 days after infection a few larvae and minute haemorrhages were found in the brain of one calf. At 7, 14 and 28 days, numerous parasites, perivascular cuffing and granulomata were present in the brain and spinal cord; 56 days after infection only a few scattered perivascular cuffs remained. At days 7, 14 and 28 epidural, intradural and occasional subdural inflammatory infiltrates with eosinophils and monocytes were seen surrounding some spinal nerve roots. Their occurrence was associated with the presence of the parasite under the adjoining arachnoidea or pia mater. These periradicular infiltrates may be associated with a host response to the parasite antigens released into the cerebrospinal fluid and subsequently leaked along the nerve roots. The radicular symptoms in these abnormal hosts are compared with those found in man, another abnormal host of *Angiostrongylus*. (10 photomicrographs.) P.S.G.

3742—JINDRÁK, K., 1970. "The pathology of intracranial angiostrongylosis in rats." *J. comp. Path.*, 80 (2), 287-297.

Rats given 100 to 1,500 3rd-stage *Angiostrongylus cantonensis* larvae by oesophageal tube were killed at various times after infection, and the concentration of larvae in different parts of the nervous system was determined. Shortly after infection, larvae migrated in high concentrations from the spinal cord to the telencephalon and lesions and eosinophilic infiltrations were found in the muscles and in and around many nerves, suggesting that some larvae migrated to the spinal cord along or through nerves. In the brain, granulomas appeared around cast skins and dead parasites 5 days after infection. The entrance of the parasites into the subarachnoid space at 10 to 12 days after infection was accompanied by plasmocytic infiltration in the dural walls of cerebral sinuses and in arachnoid villi near the ostia of cerebral veins. These veins and the subarachnoid space became dilated. Large duro-arachnoid herniae protruded into the extracranial veins. Inflammatory infiltrations formed epidurally around the spinal nerve roots and optic nerves. The worms left the cranial cavity by entering ruptured cerebral veins. Pathogenesis is discussed.

2401—JINDRÁK, K., & ALICATA, J. E., 1965. "A case of parasitic eosinophilic meningo-encephalitis in Vietnam probably caused by *Angiostrongylus cantonensis*." *Ann. trop. Med. Parasit.*, 59 (3), 294-300.

3425—JINDRÁK, K. & ALICATA, J. E., 1968. "Comparative pathology in experimental infection of pigs and calves with larvae of *Angiostrongylus cantonensis*." *J. comp. Path.*, 78 (3), 371-382.

Pigs and calves were orally infected with 20,000 and 70,000 3rd-stage *Angiostrongylus cantonensis* larvae respectively. Living normal larvae without evidence of further development were isolated from the visceral organs of the pig 3 days after infection and of calves up to 28 days after infection. Larvae recovered from pigs and calves 3 days after infection were capable of producing cerebral infection in rats but after 3 days, larvae from calves failed to produce infection in rats although evidence was inconclusive owing to the small number used. In pigs, disintegrating larvae were found in granulomata in the wall of the digestive tract and in mesenteric and mediastinal lymph nodes. In calves the larvae were found mostly in pulmonary lymphatics and mediastinal lymph nodes. Granulomatous reaction was delayed and several larvae were found apparently intact in the lungs 28 days after infection. An interstitial focal hepatitis was found in pigs but not in calves. Migration to the central nervous system of 4th-stage larvae was observed in one pig and 5 calves. K.H.

3419—JINDRÁK, K. & ALICATA, J. E., 1969. "Effect of l-tetramisole on *Angiostrongylus cantonensis* infection in rats." *Chemotherapy*, 14 (4), 244-252.

The effect of l-tetramisole was tested against the 3rd and the intracranial stages of *Angiostrongylus cantonensis* in experimentally-infected rats. The 3rd-stage larvae were relatively resistant to a single dose of 80 mg. per kg. body-weight administered at 10, 20, 32 and 48 hours post-infection. The drug was more effective when given in 2 doses of 80 mg. per kg. at 72 and 96 hours post-infection or later. 2 doses of 80 mg. per kg. given on days 5 and 6, 10 and 11, 22 and 23 post-infection killed all the parasites. A single dose of 4 to 32 mg. per kg. given 6 hours before infection considerably reduced the number of parasites which were subsequently able to migrate and develop in the brain. J.H.B.

813—JINDRÁK, K. & ALICATA, J. E., 1970. "Experimentally induced *Angiostrongylus cantonensis* infection in dogs." *Am. J. vet. Res.*, 31 (3), 449-456.

Third-stage larvae of *Angiostrongylus cantonensis* given orally and by subcutaneous injection, produced lesions in the central nervous system of 5 dogs. Approximately 11 days after infection the dogs developed slight paresis of the hind legs and hypersensitivity of the skin, which lasted 14 days. There was no evidence that the parasite had reached the lungs in 2 dogs killed 60 and 90 days after infection. D.A.Cz.

- 2876—KAGAN, I. G. & ZAIMAN, H., 1964. "Evaluation of helminth skin-test antigens in a hospital in New York City." *American Journal of Tropical Medicine and Hygiene*, 13 (1), 82-88.
- Intradermal tests using antigens from adult *Angiostrongylus cantonensis*, *Dirofilaria immitis* and *Schistosoma mansoni* and from larval *Trichinella spiralis* were carried out on 88 persons born in Puerto Rico (26% of whom were infected with intestinal helminths) and on 259 who were not of Puerto Rican origin and most of whom had been born in the U.S.A. Significant differences were observed in the responses of the 2 groups. 18.2% of the Puerto Rican group were positive for *A. cantonensis*, 11.4% for *D. immitis*, 27.2% for *S. mansoni* and 10.2% for *T. spiralis*; equivalent responses for the other group were 0%, 1.2%, 0.8% and 3.5%. J.H.B.
- 1719—KAMIYA, M., 1969. "Haemagglutination test of rat sera infected with *Angiostrongylus cantonensis*." *Proceedings of seminar on filariasis and immunology of parasitic infections and laboratory meeting*, Singapore, 1968, pp. 73-75.
- Sera of albino rats experimentally infected with 20 to 60 larvae of *Angiostrongylus cantonensis* were tested by indirect haemagglutination tests using tanned sheep erythrocytes. The antigen was a crude buffered extract of whole worms homogenized and sonically disintegrated. Results showed none positive amongst 32 uninfected controls. 34 out of 40 infected rats gave titres of from 1:32 to 1:16,384 and negative results were found mainly in the early stages of infection. Examination of sera of 18 rats infected with other helminths gave only 2 positive reactions with titres of 1:64. K.H.
- 3612—KAMIYA, M., 1970. "Haemagglutination test in rats infected with *Angiostrongylus cantonensis*." [Demonstration.] *SEast Asian J. trop. Med. publ. Hlth*, 1 (4), 570-571.
- 3614—KAMIYA, M. & KLONKAMNUAN-KARN, K., 1970. "Fractionation of serum of rats infected with *Angiostrongylus cantonensis* by Sephadex G-200 chromatography." [Demonstration.] *SEast Asian J. trop. Med. publ. Hlth*, 1 (4), 572-573.
- 3615—KAMIYA, M. & KLONKAMNUAN-KARN, K., 1970. "Immunological response of rabbits infected with *Angiostrongylus cantonensis*." [Demonstration.] *SEast Asian J. trop. Med. publ. Hlth*, 1 (4), 573.
- 3616—KAMIYA, M., KLONKAMNUAN-KARN, K. & BUNNAG, D., 1970. "Evaluation of hemagglutination (HA) test for the diagnosis of *Angiostrongylus cantonensis* in man." [Demonstration.] *SEast Asian J. trop. Med. publ. Hlth*, 1 (4), 574.
- 1635—KAMIYA, M.; KLONKAMNUAN-KARN, K.; HARINASUTA, C., 1971. "Experimental infection of *Angiostrongylus cantonensis* in rats by subcutaneous and intraperitoneal inoculations." *SEast Asian J. trop. Med. publ. Hlth*, 2 (2), 233-236. [En] Faculty of Tropical Medicine, Mahidol University, Bangkok, Thailand.
- Of 30 rats each given 50 *Angiostrongylus cantonensis* larvae, 10 were infected orally, 10 by subcutaneous injection and 10 by intraperitoneal injection. The average recovery rates of adult worms at 6 weeks were 43, 67.3 and 62.7%, respectively. This indicates not only that subcutaneous or intraperitoneal experimental infections are more effective than oral infection, but also that infection may be established in nature by penetration through wounds or abrasions of the skin. C.W.G.
- 3227—KAMIYA, M. & WONGPISAL, T., 1970. "Experimental infection of *Angiostrongylus cantonensis* in rats by subcutaneous and intraperitoneal inoculations." [Demonstration.] *SEast Asian J. trop. Med. publ. Hlth*, 1 (4), 569-570.
- 2402—KETSUWAN, P. & PRADATSUNDARASAR, A., 1966. "Second case of ocular angiostrongyliasis in Thailand." *Am. J. trop. Med. Hyg.*, 15 (1), 50-51.
- A female *Angiostrongylus cantonensis* was removed from the anterior chamber of the eye of a 22-year-old Thai male in Nakornrajsima (Korat) Province. [A.S.]
- 1044—KNAPP, S. E., 1966. "Distribution of *Angiostrongylus cantonensis* larvae in the giant African snail, *Achatina fulica*." *J. Parasit.*, 52 (3), 502.
- Only 1.3% and 8% of the infective larvae of *Angiostrongylus cantonensis* from 5 and 8 *Achatina fulica* respectively were recovered from the foot. T.Y.
- 1893—KNAPP, S. E. & ALICATA, J. E., 1967. "Failure of certain clams and oysters to serve as intermediate hosts for *Angiostrongylus cantonensis*." *Proc. helminth. Soc. Wash.*, 34 (1), 1-3.
- First-stage larvae of *Angiostrongylus cantonensis* were used in an attempt to infect *Venerupis philippinarum* and *Crassostrea virginica*. Larvae were either injected into the tissues or placed in aquaria with the molluscs. Examination of the bivalves by press preparation or artificial digestive methods revealed no developing larvae. No evidence of natural infections with *A. cantonensis* larvae was observed in 150 *V. philippinarum* and 100 *C. virginica* from Oahu Island, Hawaii, nor from 50 *Matra thaenumi* collected in the Palau Islands. M.B-B.
- 893—KUNTZ, R. E. & MYERS, B. J., 1964. "The lung worm *Angiostrongylus cantonensis* of rodents on Taiwan (Formosa) and the offshore islands." *American Journal of Tropical Medicine and Hygiene*, 13 (5), 686-692.
- Angiostrongylus cantonensis* was found in 99 of 1,650 murid rodents examined on Taiwan and the offshore islands between 1957 and 1962. 25.3% of *Bandicota indica nemorivaga* were infected, 4.2% of *Rattus coxinga coxinga*, 7.6% of *R. losea*, 7.9% of *R. norvegicus*, 1.6% of *R. rattus mindanensis* and 3.3% of an undetermined subspecies of *R. rattus* endemic to the area; all except *R. norvegicus* are new hosts for *A. cantonensis*. No infected rodents were found during additional surveys in eastern Taiwan (Hua-lien) and on the Pescadores Islands but 1 of 64 *R. rattus mindanensis* from the Orchid Island (Botel Tobago) yielded some *A. cantonensis* remnants. Previous records of *A. cantonensis* in mammalian hosts are listed. J.H.B.
- 177—KWO, E. H. & KWO, I. H., 1968. "Occurrence of *Angiostrongylus cantonensis* in rats in North Sumatra, Indonesia." *J. Parasit.*, 54 (3), 537.
- 10 of 80 *Rattus rattus diardii* and 5 of 13 *R. tiomanicus jalorensis* in or near Medan city, North Sumatra, Indonesia, were infected with *Angiostrongylus cantonensis*. This is the first confirmed record of this parasite from Indonesia, although it has previously been suspected as a cause of eosinophilic meningitis in man [see *Helminth. Abstr.*, 32, No. 1845.]. M.R.N.S.

3978—LATONIO, A. A., 1970. "The giant African snail, *Achatina fulica*. A new threat to public health." [Demonstration.] *Trans. R. Soc. trop. Med. Hyg.*, 65 (1), 22.

1020—LEE, S. H., 1967. "Sex ratio and distribution of *Angiostrongylus cantonensis* in laboratory-infected white rats." *J. Parasit.*, 53 (4), 830.

Almost equal numbers of male and female *Angiostrongylus cantonensis* were found in the lungs and pulmonary arteries of 30 rats. In the heart and main pulmonary arteries, however, over 75% of 708 worms collected were females. R.C.A.

1033—LEE, S. H., 1967. "Absence of *Angiostrongylus cantonensis* (Cheng, 1935) among rodents trapped on Tokelau Islands." *J. Parasit.*, 53 (5), 1054.

100 *Rattus exulans* from the Pacific Islands of Tokelau were not infected with *Angiostrongylus cantonensis*. *Metathelazia* sp. was found in some of the rats. R.C.A.

1725—LEE, S. H., 1969. "The use of irradiated third-stage larvae of *Angiostrongylus cantonensis* as antigen to immunize albino rats against homologous infection." *Proc. helminth. Soc. Wash.*, 36 (1), 95-97.

Of 6 rats which received 2 feedings of 200, 40 kr.-irradiated 3rd-stage larvae of *Angiostrongylus cantonensis*, 2 became completely refractory and 4 showed significant resistance when challenged with normal larvae. 20 kr. radiation not only destroyed the germ cells of *A. cantonensis*, but also caused most of the young adults to lose their ability to migrate to the lungs of their definitive host.

[A.S.] P.S.G.

3325—LÉON-DANCEL, D. DE, 1970. "Experimental infection of *Pomacea australis* (d'Orbigny), refractive for *Fasciola hepatica* (L.), receptive to *Angiostrongylus cantonensis* (Chen)." *J. Agric. Univ. P. Rico*, 54 (2), 411-412.

One-day-old, 2-month-old and 6-month-old *Pomacea australis* were exposed to hatching *Fasciola hepatica* eggs for 4 hours at room temperature, then removed to non-infested water. 3 and 6 weeks later no *F. hepatica* rediae were found in any of the snails. 3 similar groups of snails were exposed to first-stage larvae of *Angiostrongylus cantonensis* for 7 hours and examined 4 weeks later. 87% of the snails which were a day old at exposure and 9% of those 2 months old at exposure contained 3rd-stage larvae of *A. cantonensis* which became adult 30 days after being fed to white rats.

M.T.F.

2570—LEON, D. D. DE & SAULOG, T. M., 1965. "Occurrence of *Angiostrongylus cantonensis* in the brown rat (*Rattus norvegicus*) in Manila, P.I." *J. Parasit.*, 51 (6), 947.

6 of 177 *Rattus norvegicus* from districts of Manila were infected with *Angiostrongylus cantonensis*. This is the first record of *A. cantonensis* in the Philippines [but see No. 2571 below]. T.Y.

896—LIM, B. L., 1966. "Land molluscs as food of Malayan rodents and insectivores." *J. Zool., Lond.*, 148 (4), 554-560.

Laboratory and field studies on the food of rats in Malaya indicate that, when present in large numbers,

molluscs form a large part of rat food. The preferences of different rat species for different molluscs are described. Both *Macrochlamys resplendens* and *Microparmarion malayanus* are readily eaten, both being excellent hosts for *Angiostrongylus cantonensis*. In areas where rats and molluscs are both common, a high rate of *Angiostrongylus* infection in intermediate and final hosts is found. Various insectivores were also found to feed on molluscs, but were apparently not suitable hosts for *A. cantonensis*.

P.S.G.

2678—LIM, B. L., 1967. "Occurrence of *Angiostrongylus cantonensis* in rats around Kuching, Sarawak." *Ann. trop. Med. Parasit.*, 61 (4), 429-431.

A survey was made of *Angiostrongylus cantonensis* infection among 162 wild rodents from rice fields, scrub vegetation and secondary forest on the outskirts of Kuching, Sarawak, Malaysia. 6 of 75 *Rattus rattus diardi*, 4 of 31 *R. jalorensis* and 3 of 9 *R. exulans* were found infected. No infections were found in 2 *R. argentiventer*, 13 *R. muelleri*, 19 *R. whiteheadi* and 13 *R. cremoriventer*. 11 of 100 rats from scrub vegetation and 2 of 22 from rice fields were found infected, but none of 40 from secondary forest. 3 possible molluscan intermediate hosts, *Achatina fulica*, *Microparmarion malayanus* and *Macrochlamys resplendens*, were common in scrub areas, but they were not examined for infective larvae.

[A.S.] P.S.G.

1914—LIM, B. L., 1968. "Preliminary cross-infection immunity studies on two strains of *Angiostrongylus cantonensis* (Nematoda: Metastrongylidae)." [Demonstration.] *Med. J. Malaya*, 22 (3), 233-234.

1578—LIM, B. L., 1970. "Experimental infections of *Angiostrongylus cantonensis* in the Malayan mongoose." *J. Parasit.*, 56 (5), 943.

Of 32 *Herpestes auropunctatus* found in northern West Malaysia, 16 were free of helminths and 16 were infected. All of these were infected with *Pulmostrongylus herpestis* and 6 with dicrocoeliid trematodes and filarioid worms. All animals were given 2,000 infective larvae of *Angiostrongylus cantonensis* and were killed 7 to 40 days later. None of the mongooses killed after 21 days showed any signs of the experimental infection, indicating that *H. auropunctatus* is not a suitable host for *A. cantonensis*.

C.W.G.

1074—LIM, B. L., 1970. "Further studies of *Angiostrongylus cantonensis* in Kuching, Sarawak with special reference to the molluscan intermediate hosts." *SEast Asian J. trop. Med. publ. Hlth*, 1 (1), 112-116.

In a survey around Kuching, Sarawak, Malaysia, *Achatina fulica*, *Macrochlamys resplendens*, *Microparmarion malayanus*, *Laevicaulis alte* and *Pila scutata* were established as new natural intermediate hosts of *Angiostrongylus cantonensis*. Both *P. scutata* and *Achatina fulica* are eaten by man in Sarawak. 5 of 109 *Rattus rattus diardii*, 11 of 76 *R. tiomanicus jalorensis* and 3 of 8 *R. argentiventer*, trapped locally, had *Angiostrongylus cantonensis* infection. *R. argentiventer* is a new host record for Sarawak.

P.S.G.

3208—LIM, B. L., 1970. "Preliminary studies on *Angiostrongylus cantonensis* in the Malaysian mongooses." [Demonstration.] *SEast Asian J. trop. Med. publ. Hlth*, 1 (2), 297-298.

3114—LIM, B. L., 1970. "Experimental infection of primitive primates and monkeys with *Angiostrongylus cantonensis*." *SEast Asian J. trop. Med. publ. Hlth*, 1 (3), 361-365.

Sixteen *Tupaia glis* (tree shrew) and 7 *Nycticebus coucang* (slow loris) were given 1,000 infective larvae of *Angiostrongylus cantonensis* by stomach tube. 8 of the tree shrews died 8 to 25 days after infection; massive damage of meningeal brain tissues was observed. Tree shrews killed at 8 and 14 days had already developed partial paralysis, and slight haemorrhages were observed in the brain at autopsy. None of the 8 slow lorises, which were killed 8 to 32 days after infection, showed any signs of infection. 16 *Macaca fascicularis* were given 1,000, 2,000, 5,000 or 10,000 *A. cantonensis* larvae; infectivity was found to be between that in the tree shrew and the slow loris. No infection was seen in the monkeys given 1,000 or 2,000 larvae; light infections developed in those given 5,000 larvae but the worms were immature and stunted. Of 4 monkeys given 10,000 larvae and killed 5, 8, 15 and 20 days after infection only one was infected, 2 worms being found in the brain. D.A.Cz.

2979—LIM, B. L. & HEYNEMAN, D., 1965. "Host-parasite studies of *Angiostrongylus cantonensis* (Nematoda, Metastrongylidae) in Malaysian rodents: natural infection of rodents and molluscs in urban and rural areas of central Malaya." *Ann. trop. Med. Parasit.*, 59 (4), 425-433.

Rodents and molluscs were collected from towns, scrub, lalang (grassy clearing), rice fields, oil palm and rubber plantations in central Malaya and examined for *Angiostrongylus cantonensis*. The life-cycle of the parasite is maintained in all except rice fields by the slug *Microparmarion malayanus* and the land snail *Macrochlamys resplendens*. In rice fields the aquatic snails *Pila scutata*, *Bellamya ingallsiana* and *Indoplanorbis exustus* are probably the important intermediate hosts. *Rattus jalorensis*, *R. argentiventer*, *R. exulans* and *R. rattus diardi* were heavily infected in rice fields and rubber and oil palm plantations but not in lalang and *R. rattus diardi* in urban habitats was not heavily infected. D.W.L.

1639—LIM BOO LIAT & HEYNEMAN, D., 1965. "Natural infection of *Angiostrongylus cantonensis* among field rats and house shrews in different habitats of central Malaya and its implication for human eosinophilic meningoencephalitis." [Demonstration.] *Med. J. Malaya*, 20 (2), 159-161.

1729—LIM, B. L. & HEYNEMAN, D., 1969. "Further cross-infection immunity studies of three strains of *Angiostrongylus cantonensis* (Nematoda: Metastrongylidae)." *Proceedings of seminar on filariasis and immunology of parasitic infections and laboratory meeting, Singapore*, 1968, pp. 68-71. [Discussion p. 72.]

Cross immunity studies with 3 geographical strains of *Angiostrongylus cantonensis* (Thai, Hawaii and Malayan), showed that 2 doses of 10 larvae (Malayan strain) given with a 2-week interval gave white rats short-term protection against a challenge dose of 1,000 homologous larvae. No protection was found against a challenge of 1,000 larvae of Thai or Hawaii strains. A single injection of 50 larvae of Malayan strain produced less immunity than 2 doses of 10 larvae and no protection against the heterologous strains was observed. K.H.

3326—LIM, B. L. & KRISHNANSAMY, M., 1970. "Preliminary survey for *Angiostrongylus cantonensis* in edible fresh-water snails in West Malaysia." [Demonstration.] *SEast Asian J. trop. Med. publ. Hlth*, 1 (2), 295-296.

3228—LIM, B. L. & MUUL, I., 1970. "Helminth infections and reproductive rates in Malaysian wood rats." [Demonstration.] *SEast Asian J. trop. Med. publ. Hlth*, 1 (3), 421-422.

[*Angiostrongylus cantonensis* and *Hepatojarakus malayae* in *Rattus tiomanicus jalorensis*.]

278—LIM, B. L. & OMAR-AHMAD, U. D., 1969. "*Angiostrongylus cantonensis* in an isolated village in Pahang (Protostrongylidae: Nematoda)." *Med. J. Malaya*, 23 (3), 208-213.

In a village in Pahang, Malaysia, 95 of 141 rats (*Rattus argentiventer*, *R. jalorensis* and *R. exulans*) examined were infected with *Angiostrongylus cantonensis*. None of 2 *R. muelleri* and 28 *R. bowersi* were infected. 461 of 640 *Macrochlamys resplendens*, 17 of 154 *Achatina fulica*, 7 of 56 *Microparmarion malayanus* and 2 of 51 *Laevicaulis alte* were found to be infected with 3rd-stage larvae of *A. cantonensis*. Fresh lettuce leaves were contaminated with infective larvae but the deposition rate was exceedingly low. C.W.G.

973—LIM, B. L., OW-YANG, C. K. & LIE KIAN JOE, 1965. "Natural infection of *Angiostrongylus cantonensis* in Malaysian rodents and intermediate hosts, and preliminary observations on acquired resistance." *Am. J. trop. Med. Hyg.*, 14 (4), 610-617.

Angiostrongylus cantonensis was found in 219 of 526 *Rattus jalorensis*, 60 of 176 *R. argentiventer*, 28 of 141 *R. exulans*, 4 of 12 *R. norvegicus*, 80 of 863 *R. rattus diardi*, 3 of 141 *R. muelleri*, 4 of 72 *R. bowersi* and 1 of 47 *R. annandalei* trapped in the Kuala Lumpur area. None of 222 *R. sabanus*, 112 *R. rajah*, 210 *R. whiteheadi*, 21 *R. cremoriventer*, 36 *R. canus* and 5 *Chiropodomys gliroides* trapped over the same area was infected. The type of habitat of each species is given. 3rd-stage larvae were found in 552 of 1,264 *Microparmarion malayanus*, 22 of 100 *Girasia peguensis*, 37 of 350 *Laevicaulis alte*, 173 of 611 *Macrochlamys resplendens*, 1 of 189 young *Achatina fulica*, 2 of 95 *Pila scutata*, 4 of 110 *Bellamya ingallsiana* and 40 of 196 *Indoplanorbis exustus*; none of 296 *Quantula striata* and 434 *Subulina octona* was infected and no infection was found in 774 of the fresh-water shrimp, *Macrobrachium* sp., and these could not be infected experimentally. Albino rats and a laboratory strain of *R. r. jarak* developed a strong immunity after repeated infections with small numbers of worms and naturally infected *R. jalorensis* were resistant to reinfection. *R. rajah* and *R. whiteheadi* were resistant to experimental infection, only a few stunted worms, restricted to the brain, being recovered. Natural immunity in white mice and acquired immunity in *R. muelleri* were characterized by the development of stunted, abnormal worms but acquired immunity in white rats and *R. jalorensis* was characterized by the development of fewer, but normal, worms. S.W.

*2258—LOISON, G., CAVALLLO, A. & VERTENT, G., 1962. "An experimental study on the monkey of the role of *Angiostrongylus cantonensis* in the etiology of eosinophilic meningitis." *Noumea, New Caledonia: South Pacific Commission, Technical Information Circular No. 53*, 11 pp. [Mimeographed.]

456—LOISON, G., CAVALLO, A. & VERVERT, G., 1962. "Etude expérimentale chez le singe *Macacus rhesus* du rôle de l'*Angiostrongylus cantonensis* dans l'étiologie des méningites à éosinophiles observées chez l'homme dans certains territoires du Pacifique Sud." *Bulletin de la Société de Pathologie Exotique*, 55 (6), 1108-1122. [English summary p. 1120.]

The authors briefly review work done on eosinophilic meningitis in the South Pacific which led to the incrimination of *Angiostrongylus cantonensis* as the aetiological agent. They gave 100 infective larvae of *A. cantonensis* orally and intramuscularly to a *Macacus rhesus* which developed signs of eosinophilic meningitis and died 25 days after exposure; pneumonia was a complicating factor. Juvenile worms found in the brain were responsible for a meningo-encephalitis characterized by a predominance of eosinophils. Pathological signs were more acute in the monkey than in the spontaneously curable form of the disease usually encountered in humans in the South Pacific. Loison *et al.* suggest that the monkey may have been particularly susceptible, that the number of larvae given was unusually high or that additional factors such as pneumonia contributed to the acuteness of the disease. R.C.A.

10—Australian Journal of Zoology.

- a. MACKERRAS, M. J. & SANDARS, D. F., 1955.—"The life history of the rat lung-worm, *Angiostrongylus cantonensis* (Chen) (Nematoda: Metastrongylidae)." 3 (1), 1-21.

(10a) Mackerras & Sandars describe the life-cycle of *Angiostrongylus cantonensis* obtained from the pulmonary arteries of *Rattus norvegicus*, *R. rattus*, *R. culmorum* and *R. assimilis* in Australia. In experimentally infected laboratory rats the unsegmented ova are discharged into the blood stream and lodge as emboli in the smaller vessels; the first-stage larvae break through into the respiratory tract, migrate up the trachea and pass out in the faeces. *Agriolimax laevis*, and to a lesser extent, *Limax arborum* and *Onchidium* sp. proved efficient intermediate hosts. The larvae actively penetrate the slugs and perhaps are also ingested, for *A. laevis* was observed to eat rat faeces. The larvae moult twice but do not exsheath and on being eaten by the rat exsheath in the stomach. On leaving the ileum the larvae become blood-borne and congregate in the central nervous system, especially in the anterior cerebrum, where the third and fourth moults occur. Young adults emerge on the surface of the brain on the 12th to 14th day, spend two weeks in the subarachnoid space and then migrate via the venous system through the heart to the lungs. Here they continue growing and mature by the 42nd to 45th day in the rat. Cerebral derangement was observed only in heavily infected animals. Infections in white mice proved highly detrimental to both host and parasite but guinea-pigs survived well although the worms did not attain maturity. The adult and larval stages are described and the effect of the worms on the hosts are treated in detail. This is the first metastrongyle known to develop regularly in the brain of the definitive host. M.MCK.

38—Nature. London.

- f. MACKERRAS, M. J. & SANDARS, D. F., 1954.—"Life-history of the rat lung-worm and its migration through the brain of its host." [Correspondence.] 173 (4411), 956-957.

(38f) *Angiostrongylus cantonensis* is present in the pulmonary arteries of about 5% of *Rattus norvegicus* in Brisbane. The intermediate hosts are *Limax* spp. The first-stage larva enters the foot of the slug. The first moult occurs in about 12 days and the second moult five days later at 70°F. to 74°F. The third-stage larva remains within the two cast skins until the slug is eaten by the rat. The larvae enter the mesenteric veins and reach the cerebral tissues where they grow and moult about the 12th day. The immature adults emerge and move freely in the subarachnoid space. On the 29th day after infection they travel by the veins to the lungs and by the 32nd day have reached the pulmonary arteries where egg-laying begins. First-stage larvae are found in the faeces on the 40th to 45th day. R.T.L.

1996—MISHRA, G. S., 1971. "Studies on specific and non-specific reactions in rabbit inoculated with the extract of *Angiostrongylus cantonensis*." *Indian vet. J.*, 48 (8), 786-791. [En] Parasitologie, Ecole Nationale Vétérinaire, Alfort, Paris, France.

Rabbits inoculated with worm extract of *Angiostrongylus cantonensis* showed a remarkable decrease in albumin and proportional increase in γ -globulin in their sera. Significant precipitating antibodies were demonstrated in the Ouchterlony double diffusion test. [A.S.] D.A.Cz.

3592—MALARDE, L., OUTIN, D. & TAPU, J., 1967. "Meningite à éosinophiles et habitudes alimentaires en Polynésie française." Seminar on Helminthiases and Eosinophilic Meningitis, Noumea, New Caledonia, June 5-16, 1967. Noumea: South Pacific Commission. Working Paper No. 27, 5 pp.

1079—MARGONO, S. S., 1970. "*Angiostrongylus cantonensis* in Djakarta, Indonesia." [Demonstration.] *SEast Asian J. trop. Med. publ. Hlth*, 1 (1), 158-159.

1928—MASSAL, 1962. "Résumé et état actuel des recherches sur la 'méningite à éosinophiles' en Polynésie française." *Bulletin de la Société de Pathologie Exotique*, 55 (4), 734-738. [English summary p. 738.]

The work of a number of scientists at the Institut de Recherches Médicales de la Polynésie française on *Angiostrongylus cantonensis* as the causative agent of eosinophilic meningitis in Hawaii and Tahiti is summarized. S.W.

*1997—MISHRA, G. S.; GUILHON, J.; BENEX, J., 1970. [The latex test in the serological diagnosis of angiostrongyliasis.] "Le test au latex dans le diagnostic sérologique de l'angiostrongylose murine." *Bull. Soc. Path. exot.*, 63 (6), 709-716. [Fr, en]

The latex agglutination test was found to demonstrate antibodies in the sera of rats from 6 days after infection with *Angiostrongylus cantonensis*. The test is regarded as being rapid, simple, sensitive and reproducible. [From *Trop. Dis. Bull.*, 68, No. 2329.] D.A.Cz.

559—NISHIMURA, K., 1965. "Failure of infective larvae of *Angiostrongylus cantonensis* to establish prenatal infection in rats." *J. Parasit.*, 51 (4), 540.

6 pregnant albino rats were given 500–2,000 infective larvae of *Angiostrongylus cantonensis*. Larvae were not found in the brains of foetuses of 2 rats killed 3 and 7 days after infection. The remaining rats gave birth to 40 young 4–10 days after infection. 35 young were examined 2 days, and five 37 days, after birth with negative results. Mother rats examined soon after giving birth had developing worms in the brain. Apparently prenatal infection with *A. cantonensis* is rare in rats.
R.C.A.

3181—NISHIMURA, K., 1966. "Experimental studies on the chemotherapy of rat lungworm, *Angiostrongylus cantonensis*, in rats." *Chemotherapy*, Year 1965, 10, (3), 164–175. [French & German summaries p. 173.]

Studies to determine the value of various drugs against *Angiostrongylus cantonensis* infection in rats are reported. The drugs, in most cases, were given to the rats for 5 consecutive days starting 14, 17 and 21 days after infection. Bithionol, bithionol-S-oxide, foudadin and hetrazan were ineffective. Thiabendazole given at a dose rate of 200 mg. per kg. body-weight for 5 consecutive days 14 days after infection was effective in destroying all the parasites and in preventing cerebral and lung pathology. Reduction in the dose rate produced corresponding reduction in efficacy and, in some cases, the parasite growth was inhibited. The use of thiabendazole in clinical trials for treatment of human cerebral angiostrongylosis is discussed and suggested.
J.N.O.

1942—NISHIMURA, K., 1966. [*Angiostrongylus cantonensis* infection in albino rats.] *Jap. J. Parasit.*, 15 (2), 116–123. [In Japanese: English summary p. 123.]

Over 70% of *Angiostrongylus cantonensis* larvae used to infect albino rats were recovered from the

heart and lungs as adult worms at post-mortem. Heavier infections tended to reduce the length of life as the worms occlude the pulmonary artery. Pathological changes in the pulmonary arteries, lungs, brain and heart are described and illustrated, and a classification of cardiac lesions is given.
[From English summary.] P.S.G.

1641—NISHIMURA, K., 1966. "Investigations on the rat lungworm, *Angiostrongylus cantonensis*, in the Ryukyu Islands." *Jap. J. Parasit.*, 15 (3), 232–238. [Japanese summary p. 238.]

130 *Rattus norvegicus* and *R. rattus* from the islands of Okinawa, Miyako-jima, Ishigaki-jima and Iriomote-jima in the Ryukyu Islands, Japan, were examined for *Angiostrongylus cantonensis* which was found in rats from all islands at an average infection rate of 15.8%. Miyako-jima and Ishigaki-jima are new localities for *A. cantonensis*. Several 3rd-stage larvae of *A. cantonensis* were recovered, in these areas, from *Laevicaulis alte* and *Achatina fulica* which are assumed to be the natural intermediate hosts.
M.R.N.S.

1142—NISHIMURA, K., KAWASHIMA, K. & MIYAZAKI, I., 1964. "On the occurrence of the rat lungworm, *Angiostrongylus cantonensis* (Chen, 1935) in Is. Iriomote-jima, the Ryukyu Islands (Nematoda: Metastrongylidae)." *Kyushu J. med. Sci.*, 15 (5/6), 165/170.

Angiostrongylus cantonensis is reported for the first time from the Ryukyu Islands. 22 *Rattus rattus*, 5 *R. norvegicus* and 2 voles (*Suncus murinus riukiuanus*) were examined; one *R. norvegicus* was infected.
T.Y.

2571—NISHIMURA, K. & YOGORE, Jr., M. G., 1965. "On the occurrence of the rat lungworm, *Angiostrongylus cantonensis*, in rats in the Philippines." *J. Parasit.*, 51 (6), 928.

2 of 51 *Rattus norvegicus* examined at Manila in the Philippines were infected with *Angiostrongylus cantonensis*. This appears to be the first record of the parasite from the Philippines [but see No. 2570 above].
T.Y.

432—Journal of Parasitology.

f. OGREN, R. E., 1954.—"A lungworm, *Angiostrongylus blarini*, n.sp., from the short-tailed shrew, with observations on the histopathology and life cycle." 40 (6), 681–685.

(432f) *Angiostrongylus blarini* n.sp. from cysts in the lungs of the short-tailed shrew, *Blarina brevicauda*, differs from the seven other species in that the adults are small, the male being only 3–4 mm. in length, the right and left dorsal rays are fused to form an inverted T-shaped appendage, the lateral rays are fused, the slender and slightly curved spicules measure only 0.066–0.099 mm. in length. Third-stage larvae found in field specimens of the slug *Deroceras gracile*, thought to be the infective stage of this or a closely allied species, when fed to mice gave negative results.
R.T.L.

2240—OHIBAYASHI, M., & ORIHARA, M., 1968.

[Discovery of *Angiostrongylus cantonensis* (Chen, 1935) Dougherty, 1946 from a rat in Sapporo, Northern Japan.] *Jap. J. Parasit.*, 17 (1), 1–4.
[In Japanese: English summary, p. 4.]

Male and female *Angiostrongylus cantonensis* were recovered from *Rattus norvegicus* at Sapporo, Hokkaido, in the extreme north of Japan. Previous reports from Japan have been limited to the Ryukyu Islands in the extreme south. [From English summary.]
P.S.G.

- 4363—PARMETER, S. N. & CHOWDHURY, A. B., 1966. "*Angiostrongylus cantonensis* in India." *Bull. Calcutta Sch. trop. Med.*, 14 (2), 38.
- Angiostrongylus cantonensis* larvae are reported from the lungs of a *Bandicota indica* taken at Madras, India. This is the first record of this nematode from India. P.S.G.
- 110—PROMMINDAROJ, K., LEELAWONGS, N. & PRADATSUNDARASAR, A., 1962. "Human angiostrongyliasis of the eye in Bangkok." *American Journal of Tropical Medicine and Hygiene*, 11 (6), 759-761.
- A 34-year-old native of Thailand with poor vision and irritation of the right eye was found to have a keratitis and iritis due to an adult male *Angiostrongylus* embedded in the iris. The worm was removed at operation and when the patient was discharged from hospital 9 days later his vision was much improved. The parasite was probably *A. cantonensis*, the species known to be responsible for meningo-encephalitis in man in Hawaii. G.S.N.
- 1608—PUNYAGUPTA, S., 1965. "Eosinophilic meningoencephalitis in Thailand: summary of nine cases and observations on *Angiostrongylus cantonensis* as a causative agent and *Pila ampullacea* as a new intermediate host." *Am. J. trop. Med. Hyg.*, 14 (3), 370-374.
- Case histories of 9 adults, admitted to Bangkok hospital with eosinophilic meningoencephalitis and believed to be infected with *Angiostrongylus cantonensis*, are given. All complained of severe headache and had eosinophilia of the cerebrospinal fluid. Intradermal injections of crude extract of *Angiostrongylus* gave positive reactions in all but one person but 6 of 11 normal persons, 20 of 25 with other nematode infections and some patients with other complaints also reacted positively. Sera from 4 of the *Angiostrongylus* cases gave titres of 1:10, 1:20, 1:320 and 1:80 when tested by indirect tanned-cell haemagglutination with the extract; the others did not react. Some other helminth antigens elicited reactions in some of the patients. Treatment with 30 mg. prednisone per day, given orally, relieved the symptoms. One man died from miliary tuberculosis but no pathological changes were observed in the brain or spinal cord. All these patients had eaten raw or pickled *Pila ampullacea* and adult *A. cantonensis* were recovered from pulmonary arteries of 2 of 6 albino rats fed the snails from natural habitats. Rats fed *Vivipara doliaris* or *Caridina lacvis* did not become infected, *A. cantonensis* was not found in 34 *Rattus rattus*, 10 *R. norvegicus* and 6 *R. exulans* trapped in Dhonburi and Bangkok. S.W.
- 1754—PUNYAGUPTA, S. & BUNNAG, T., 1970. "Growth rate of *Angiostrongylus cantonensis* in man and rat." [Abstract.] *J. Parasit.*, 56 (4, Sect. 2), (Int. Congr. Parasit. (2nd), Washington, D.C., Sept. 6-12, 1970, Proceedings, Part I), pp. 274-275.
- 3130—PUNYAGUPTA, S., BUNNAG, T., JUTTIJUDATA, P. & ROSEN, L., 1970. "Eosinophilic meningitis in Thailand. Epidemiologic studies of 484 typical cases and the etiologic role of *Angiostrongylus cantonensis*." *Am. J. trop. Med. Hyg.*, 19 (6), 950-958.
- Investigations in Thailand have shown that the typical form of eosinophilic meningitis is prevalent and widely distributed especially in the north-eastern and central parts of the country. Most patients had eaten raw snails (*Pila*) within 30 days of onset of symptoms; 20% of 257 *Pila* were found to be infected with *Angiostrongylus cantonensis*. From these and other observations, it is concluded that most, if not all, cases of typical eosinophilic meningitis in Thailand are caused by *A. cantonensis*. D.A.Cz.
- 3610—PUNYAGUPTA, S., JUTTIJUDATA, P. & BUNNAG, T., 1967. "Eosinophilic meningo-encephalitis in Thailand." Seminar on Helminthiases and Eosinophilic Meningitis, Noumea, New Caledonia, June 5-16, 1967. *Noumea: South Pacific Commission. Working Paper No. 9*, 4 pp.
- 1728—RICHARDS, C. S., 1963. "*Angiostrongylus cantonensis*: intermediate host studies." [Abstract.] *Journal of Parasitology*, 49 (5, Sect. 2), 46-47.
- 16 of 17 species of fresh-water molluscs were suitable hosts for *Angiostrongylus cantonensis*. Larvae survived in snails for up to 12 months. First-stage larvae were rapidly killed by drying but survived and remained infective for at least a week in fresh water and for at least 3 days in sea-water. In *Australorbis glabratus*, infection occurred via the gut following ingestion of larvae. Infective larvae were susceptible to drying but remained infective in tissues 4 days after the snails had died. R.C.A.
- 119—RICHARDS, C. S. & MERRITT, J. W., 1967. "Studies on *Angiostrongylus cantonensis* in molluscan intermediate hosts." *J. Parasit.*, 53 (2), 382-388.
- Angiostrongylus cantonensis* reached the infective stage in 20 of 26 species of experimentally infected freshwater molluscs. The number of larvae recovered varied from 3 (in *Ferrissia tenuis*) to over 2,000 (in *Biomphalaria glabrata*); larvae survived for one year in the latter. 1st-stage larvae were sensitive to drying but survived at least 3 weeks in water and were infective to snails after at least 2 weeks in either fresh or sea-water. *B. glabrata* became infected by eating rat faeces. 3rd-stage larvae were sensitive to drying but survived up to 11 days in *B. glabrata* removed from water; larvae remained alive 4 days after death of the infected snails. Rats became infected by drinking water in which infective larvae were active for up to one week. Infected *B. glabrata* died quickly in sea-water but infective larvae in their tissues survived up to 5 days. The relevance of the findings to the natural transmission of *A. cantonensis* is discussed. R.C.A.
- 5448—ROSEN, L., 1966. "Eosinophilic meningitis and *Angiostrongylus cantonensis* in the Pacific area." *Int. Congr. Parasit. (1st)*, Rome, Sept. 21-26, 1964. *Proceedings*, Vol. II, pp. 799-800.
- 3862—ROSEN, L., 1967. "Biology and distribution of *Angiostrongylus cantonensis*." Seminar on Helminthiases and Eosinophilic Meningitis, Noumea, New Caledonia, June 5-16, 1967. *Noumea: South Pacific Commission. Working Paper No. 25*, 3 pp.
- The normal life-cycle of *Angiostrongylus cantonensis* involving molluscan and rodent hosts is described. Certain species of *Rattus* (*R. rattus*, *R. norvegicus*, *R. exulans*) and some genera of the Muridae are the only known definitive hosts, although the same species may not be infected in different parts of the world. This nematode has limited host specificity and often develops as far as the 5th moult before dying in the brains of non-definitive mammal hosts. A wide variety of molluscs act as secondary hosts, notably *Achatina fulica* and various veronicillid slugs, but the importance to man depends not on frequency of molluscan infection but on their frequency of ingestion by man. Infective larvae have been found in amphibians, freshwater shrimps, land crabs and planarians and it is from these paratenic hosts that man is probably most often infected. Avian and mammalian paratenic hosts do not seem to remain infective to definitive hosts for more than 24 hours. The present geographical distribution of *A. cantonensis* is described: it is expected that it will continue to spread through the Pacific region to areas of suitable environment (e.g. Samoa) by human introduction. P.S.G.

3093—ROSEN, L., 1968. "Recent advances in knowledge of *Angiostrongylus* in relation to eosinophilic meningitis in the Pacific area." [Abstract.] *Int. Congr. trop. Med. Malar.* (8th), *Teheran*, Sept. 7-15, 1968. Abstracts and reviews, pp. 231-232.

*152—ROSEN, L., CHAPPELL, R., LAQUEUR, G. L., WALLACE, G. D. & WEINSTEIN, P. P., 1962. "Eosinophilic meningocencephalitis caused by a metastrongylid lung-worm of rats." *J. Am. med. Ass.*, 179 (8), 620-624.

1062—ROSEN, L., LAIGRET, J. & BORIES, S., 1961. "Observations on an outbreak of eosinophilic meningitis on Tahiti, French Polynesia." *American Journal of Hygiene*, 74 (1), 26-42. Several hundred cases of an unusual type of meningitis occurred on Tahiti between March 1958 and March 1960 of which the most common symptoms were headache, stiffness of the neck and back and localized areas of paraesthesia. Approximately 5% had facial paralysis of the lower motor neurone type; none had subcutaneous nodules. Antibiotic, antihistaminic and antiparasitic drugs were without effect. In most patients there were more than 500 cells per cu.mm. of cerebrospinal fluid, of which at least 25% were eosinophils. Some persons who showed symptoms of the disease without the cerebrospinal fluid findings and a few others who showed these findings but no symptoms are not considered further. Various serological tests and examination of the cerebrospinal fluid directly, by culture or by animal inoculation failed to reveal any causative organisms. The majority had blood eosinophilia. Faecal examination "failed to reveal the presence of protozoal or helminthic parasites other than the occasional presence of those commonly found in most inhabitants of French Polynesia". The sex incidence was equal and there was no obvious seasonal variation in incidence; few young children appeared to be infected. The illness lasted from several days to several months with an incubation period estimated at 2 to 4 weeks; recurrences were common. Epidemiological studies suggested that the disease was caused by some helminth parasite of a pelagic fish commonly eaten raw in the area. However, in an addendum it is reported that the brain of an adult male Filipino who died with an eosinophilic meningocencephalitis in a mental hospital in the Hawaiian Islands contained young adult *Angiostrongylus cantonensis*. [See also abstract No. 1031 above.] J.W.S.

2203—ROSEN, L., LOISON, G., LAIGRET, J. & WALLACE, G. D., 1967. "Studies on eosinophilic meningitis. 3. Epidemiologic and clinical observations on Pacific Islands and the possible etiologic role of *Angiostrongylus cantonensis*." *Am. J. Epidem.*, 85 (1), 17-44.

The evidence for the aetiological role of *Angiostrongylus cantonensis* in the eosinophilic meningitis seen on the Pacific Islands and the possible methods of transmission are reviewed in detail. Data were collected in French Polynesia, Tahiti, New Caledonia, Hawaii, Ponape, Guam and Saipan. A study of diet among patients on most of the islands showed that the only types of raw animal food eaten frequently within 4 weeks preceding the onset of symptoms were freshwater shrimps. 0.1 to 0.6% of *Macrobrachium* lar were found to harbour nematodes resembling 3rd-stage *A. cantonensis*. Shrimps could not be incriminated in New Caledonia or the Hawaiian islands. M.B-B.

176—SALAZAR, N. P., 1970. "Commensal rodents and their parasites in Manila and suburbs." [Demonstration.] *SEast Asian J. trop. Med. publ. Hlth*, 1 (1), 163.

1776—SALAZAR, N. P.; CABRERA, B. D., 1969. "*Angiostrongylus cantonensis* in rodent and molluscan hosts in Manila and suburbs." *Acta med. philipp.*, 6 (1), 20-25. [En]

In Manila, Philippines, and the surrounding area, *Angiostrongylus cantonensis* was found in 1.07% of *Rattus norvegicus* and 0.68% of *R. rattus* but not in mice or shrews. 18.18% of black slugs (*Laevicaulis alte*), 5.63% of brown slugs (*Imerinia plebeia*) and 4.52% of *Achatina fulica* were found to be infected. No naturally infected edible freshwater molluscs were found. [From *Trop. Dis. Bull.*, 68, No. 2328.] D.A.Cz.

47—Transactions of the Royal Society of Tropical Medicine and Hygiene

- j. SANDARS, D. F., 1955.—"The life cycle of the rat lungworm, *Angiostrongylus cantonensis* (Chen) (worked out by M. J. Mackerras and D. F. Sandars)." [Demonstration.] 49 (1), 11.

(47j) *Agriolimax laevis* and other British slugs can act as intermediate hosts for *Angiostrongylus cantonensis* which undergoes two moults in the slug. In the rat, its definitive host, the larvae pass by the blood stream to the cerebrum within 24 hours, moult twice, and at about the 12th day pass to the surface of the brain whence they force their way into the veins between the 28th and 31st day and, passing through the heart, finally reach their normal habitat in the pulmonary arteries. R.T.L.

27—Nature. London.

- a. SANDARS, D. F., 1957.—"Lungworm from rats captured in Britain." [Correspondence.] 179 (4550), 109-110.

(27a) *Angiostrongylus cantonensis*, an oriental lungworm of rats, has spread to Australia. During a visit from Australia Sandars examined 24 *Rattus rattus* and 167 *R. norvegicus* caught in various English towns but found no evidence of the occurrence of this parasite in England. [The title is therefore misleading.] R.T.L.

3081—SCHOLLHAMMER, G., LEGAIT, J. P. & COURDURIER, J., 1968. "Recherche sur *Angiostrongylus cantonensis*" (Chen, 1935) en République de Haute-Volta. I. Note préliminaire." *Bull. Soc. Path. exot.*, **61** (3), 441-444. [English summary p. 444.]

Forty-five rats, some of which were tentatively identified as *Rattus norvegicus* and *R. rattus*, and one unidentified species known as "rat voleur" or "rat toto", mainly from urban areas in the Bobo-Dioulasso, Upper Volta, were not infected with *Angiostrongylus cantonensis*. R.C.A.

3794—SCHOLLHAMMER, G., LEGAIT, J. P. & COURDURIER, J., 1969. "Recherches sur *Angiostrongylus cantonensis* (Chen, 1935) en République de Haute-Volta. II. Résultats de la deuxième enquête dans la zone urbaine de Bobo-Dioulasso." *Bull. Soc. Path. exot.*, **62** (4), 731-733.

Examination of *Cricetius gambianus*, *Rattus r. rattus*, *R. r. frugivorus*, *Mastomys gris* and "musaraigne" from an urban area of Bobo Dioulasso, Upper Volta, Africa, failed to reveal the presence of *Angiostrongylus cantonensis*. R.C.A.

2638—SHOHO, C., 1966. "Observations on rats and rabbits infected with *Angiostrongylus cantonensis* (Chen)." *Br. vet. J.*, **122** (6), 251-258.

The cerebral stage of *Angiostrongylus cantonensis* was experimentally studied in rabbits and rats. Penetration of the larvae into the central nervous system was usual in rats but unusual in rabbits and the clinical manifestations of neurological disorder were obscure or not detectable in rats but evident in rabbits. Occasionally, in heavy infections, one or 2 worms were observed under the dura mater of the optic nerve of rats. No eosinophils were found in the meninges or the brain of either rats or rabbits. The lesions of "cerebrospinal setariasis" of domestic animals (sheep, goats and horses) are compared to those of "cerebrospinal angiostrongylosis". [A.S.]

5152—SHOHO, C., 1966. "Le complexe neuro-oculaire de la nématodose cérébrospinale." *Int. Congr. Parasit.* (1st), Rome, Sept. 21-26, 1964. Proceedings, Vol. II, pp. 836-837.

1514—SIMPSON, T. W., YONAMINE, T., HANZAN, E., NISHIHARA, T. & CHINEN, S. S., 1970. "Eosinophilic meningitis in Okinawa. Three suspected cases of angiostrongyliasis in man." *Am. J. trop. Med. Hyg.*, **19** (5), 770-774.

Three cases of eosinophilic meningitis in man were observed in 1969 in Okinawa, in the Ryukyu Islands between latitudes 26° 04' and 26° 52½' North. Each of the patients exhibited a clinical picture similar to that seen in *Angiostrongylus cantonensis* infections elsewhere in the Pacific Ocean area and South-East Asia. This metastrongylid is endemic in *Rattus norvegicus* and *R. rattus* in Okinawa and certain other islands of the southern Ryukyus. Infection in man had been acquired by direct contact with an intermediate host *Achatina fulica*, in one case by eating the snails raw, but other modes of transmission were not excluded. These are the first suspected cases of angiostrongyliasis in man in the Ryukyu Islands and thought to be the only cases reported in the subtropics at this latitude. [A.S.] M.R.N.S.

1845—SMIT, A. M., 1962. "Eosinophilic meningitis at Kisaran (Indonesia) and the problem of its aetiology." *Bulletin de la Société de Pathologie Exotique*, **55** (4), 722-730. [French summary p. 728.]

Smit describes the findings in 8 cases of eosinophilic meningitis in Indonesian patients; hookworm ova were present in the faeces of 6, *Ascaris* ova in 6 and *Strongyloides* larvae in 2; none showed microfilariae in the blood or clinical symptoms of filariasis. 4 were treated with hetrazan, one with cortisone and one with phenergan but there was no perceptible effect on the course of the disease. All showed eosinophilia of the blood and cerebrospinal fluid. All recovered after 2 to 12 weeks and no residual symptoms were observed. The recorded cases of eosinophilic meningitis are divided into 2 groups: (i) sporadic eosinophilic meningitis of which scattered cases have been observed in several countries and which may be assumed to have been caused by different helminthic infections; (ii) endemic or epidemic eosinophilic meningitis which occurs on a few islands in the Pacific and is probably caused by *Angiostrongylus cantonensis*. The Indonesian cases described in this paper probably belong to the second group. S.W.

2193—SMIT, A. M., 1963. "Eosinophilic meningitis." *Tropical and Geographical Medicine. Amsterdam*, **15** (3), 225-232. [Spanish summary p. 232.]

Details are given of 5 of 8 cases of eosinophilic meningitis from the east coast of Sumatra. Cells in the cerebrospinal fluid varied from 293 to 4,244 per cu. mm. and the percentage of eosinophils from 30 to 90. One case had a severe clinical course with abdominal pains, shortness of breath, heaviness of the appendages, paresis, mental disturbance and incontinence but total recovery ensued 7 weeks later. Other cases were less severe but headaches, fatigue, vertigo and facial paralysis were recorded. The author discusses the possibility that *Angiostrongylus cantonensis* may have been involved. R.C.A.

1937—SODEMAN, T. M., SODEMAN, Jr., W. A. & RICHARDS, C. S., 1969. "The intrapulmonary localization of *Angiostrongylus cantonensis* in the rat." *Proc. helminth. Soc. Wash.*, **36** (1), 143-146.

In rats experimentally infected with *Angiostrongylus cantonensis*, adult worms were found only in the larger pulmonary arteries. No evidence was found to indicate penetration of pulmonary parenchyma by the adults. Oviposition occurred in the blood stream and the wide distribution of pulmonary involvement resulted from embolization of eggs. It is suggested that the arterial system is the primary site of development and that the pulmonary parenchyma acts as a secondary site when eggs escape from the vascular system. C.W.G.

295—TANGCHAI, P., NYE, S. W., & BEAVER, P. C., 1967. "Eosinophilic meningoencephalitis caused by angiostrongyliasis in Thailand. Autopsy report." *Am. J. trop. Med. Hyg.*, **16** (4), 454-461.

697—WALLACE, G. D. & ROSEN, L., 1965. "Studies on eosinophilic meningitis. I. Observations on the geographic distribution of *Angiostrongylus cantonensis* in the Pacific area and its prevalence in wild rats." *American Journal of Epidemiology*, 81 (1), 52-62.

From July, 1961 to April, 1964 the authors examined 2,500 rats (*Rattus norvegicus*, *R. rattus* and *R. exulans*) from the Marshall Islands, Fiji, Tonga, Western Samoa, American Samoa, Hawaii and the Society Islands for information on *Angiostrongylus cantonensis*. It was particularly surprising not to find the nematode in rats from Fiji, Western Samoa and American Samoa; it has previously been found on island groups both east and west of these areas in the South Pacific. The morphological similarity of larvae from slugs in Fiji to those of *A. cantonensis* does not establish the presence of the species on the island; the larvae were not fed to rats and could have been those of another metastrongylid. A previous report of *A. cantonensis* on Majuro, Marshall Islands, may have been the result of a misidentification of another nematode, e.g. a species of *Metastrongylus*. The role of *R. exulans*, *R. rattus*, *R. norvegicus* and the giant African snail, *Achatina fulica*, in spreading *Angiostrongylus cantonensis* in the Pacific islands is briefly discussed. The various rodents that have been found naturally infected with *A. cantonensis* are listed. No major differences in prevalence from one island to another were noted. The degree of infection was equal in both sexes and tended to be slightly higher in the larger specimens of the 3 species investigated. *A. cantonensis* was generally more prevalent in *R. norvegicus* than in *R. rattus* and *R. exulans*. H.H.W.

1552—WALLACE, G. D. & ROSEN, L., 1966. "Studies on eosinophilic meningitis. 2. Experimental infection of shrimp and crabs with *Angiostrongylus cantonensis*." *Am. J. Epidemiol.*, 84 (1), 120-131.

3rd-stage larvae of *Angiostrongylus cantonensis* were found in the viscera of *Macrobrachium* lar and *Ocypode ceratophthalma* after being fed infected molluscs. Larvae were found in shrimps up to 29 days later; they were passed or migrated out of the shrimps for several days after feeding. Larvae were found in crabs up to 3 days after infection. The possible significance of these observations in the transmission of *A. cantonensis* to man is discussed. R.C.A.

1231—WALLACE, G. D. & ROSEN, L., 1967. "Studies on eosinophilic meningitis. 4. Experimental infection of fresh-water and marine fish with *Angiostrongylus cantonensis*." *Am. J. Epidemiol.*, 85 (3), 395-402.

Molluscs with infective larvae of *Angiostrongylus cantonensis* were fed to *Tilapia mossambica* (fresh-water) and *Trachurops crumenophthalmus* (marine). Larvae of *A. cantonensis* were recovered from the viscera and musculature of both up to 4 weeks after infection. The possible role of fish in transmission of human eosinophilic meningitis in the South Pacific is discussed in the light of these observations; *T. crumenophthalmus* may ingest infected molluscs washed into the sea during rain storms. R.C.A.

850—WALLACE, G. D. & ROSEN, L., 1969. "Studies on eosinophilic meningitis. VI. Experimental infection of rats and other homoiothermic vertebrates with *Angiostrongylus cantonensis*." *Am. J. Epidemiol.*, 89 (3), 331-344.

3rd-stage *Angiostrongylus cantonensis* larvae from *Biomphalaria glabrata* were fed to mice, rats, chickens, pigs, dogs and mongooses, and their migration through the tissues was studied. In rats and mice, larvae passed first to the liver, then to the lungs and then into the blood stream. From here they entered the central nervous system and migrated to the brain—mostly within 48 hours of infection. In rats there was a strong migration from the brain to the heart and lungs between days 25 and 32 after infection; during this period, larvae were normally found in the spinal cord only with high infections (500 larvae). In mice (but not rats), males showed a greater susceptibility to infection than females and the disease was more severe. Few viable larvae were recovered from chickens and pigs and it is thought unlikely that they could act as intermediate hosts for human infections. *A. cantonensis* did not complete its development cycle in dogs or mongooses. M.R.N.S.

1467—WALLACE, G. D., & ROSEN, L., 1969. "Experimental infection of Pacific island mollusks with *Angiostrongylus cantonensis*." *Am. J. trop. Med. Hyg.*, 18 (1), 13-19.

Terrestrial, aquatic and amphibious molluscs from Pacific islands were tested for susceptibility to infection with *Angiostrongylus cantonensis*. The terrestrial molluscs included 5 introduced species that occur commonly on high islands and 11 species typical of coral atolls. *Laevicaulus alte* was found to be highly susceptible whereas *Subulina octona*, *Prosopis javanicum* and *Bradybaena similis* were relatively resistant. *Deroceras laeve* was of intermediate susceptibility. As a group, the atoll species were relatively resistant to *A. cantonensis*. With the exception of *Biomphalaria glabrata*, a laboratory-cultured aquatic snail not indigenous to the Pacific, the freshwater snails were either completely or partially resistant. Attempts to infect one species of oyster were unsuccessful. M.R.N.S.

2666—WALLACE, G. D. & ROSEN, L., 1969. "Studies on eosinophilic meningitis. V. Molluscan hosts of *Angiostrongylus cantonensis* on Pacific islands." *Am. J. trop. Med. Hyg.*, 18 (2), 206-216.

In an investigation into the intermediate hosts of *Angiostrongylus cantonensis* on Pacific islands, molluscs found most infected were: *Laevicaulus alte*, *Euglandina rosea* and *Achatina fulica* on Oahu, Hawaii, *Vaginulus plebeius*, *Subulina octona* and *Deroceras laeve* on Tahiti, Society Islands, and *V. plebeius*, *Bradybaena similis* and *S. octona* on Rarotonga, Cook Islands. No infected snails were found on the coral atoll of Majuro, Marshall Islands. No seasonal variations in incidence of infection were observed, but in drier areas fewer molluscs were infected—usually with smaller numbers of larvae. Factors which contribute to a mollusc being a good intermediate host are discussed, as is the role of molluscs in the transmission of *Angiostrongylus cantonensis* to rat and man. C.W.G.

4339—WATTS, M. B., 1969. "Five cases of eosinophilic meningitis in Sarawak." *Med. J. Malaya*, 24 (2), 89-93.

The first 5 cases of eosinophilic meningitis occurring in Malaysia, are reported. The clinical picture was that of a subacute meningitis with eosinophilic pleocytosis on lumbar puncture and a relatively benign course. All were treated with diethylcarbamazine at a dosage of 6 mg. per kg. body-weight daily for 21 days. It seems doubtful whether diethylcarbamazine affected the course of the illness, but prednisone did alleviate symptoms in two cases. Evidence is put forward suggesting *Angiostrongylus cantonensis* as the aetiological agent and the ingestion of raw fruit or vegetables contaminated by molluscs as the mode of infection. [A.S.] P.S.G.

1380—WEINSTEIN, P. P., ROSEN, L., LAQUEUR, G. L. & SAWYER, T. K., 1962. "*Angiostrongylus cantonensis* infection in rats and rhesus monkeys and survival of the parasite *in vitro*." [Abstract.] *Journal of Parasitology*, 48 (2, Sect. 2), 51-52.

Angiostrongylus cantonensis larvae from *Rattus* sp. in Hawaii developed to infective third-stage larvae in *Limax maximus* and *Deroceras reticulatum* from Maryland, U.S.A. Rats infected with 10 larvae each had mean faecal larval counts between 6,000 and 10,000 per c.c. faeces; rats harbouring between 61 and 72 adults died 76 to 102 days after infection and had faecal counts of over 100,000 per c.c. faeces. Adult worms derived from these rats and cultured *in vitro* have survived approximately 9 weeks in medium NCTC 109 containing 10% horse serum. Three rhesus monkeys were infected with *A. cantonensis* larvae and eosinophilic meningo-encephalitis was found in two at autopsy on the 17th and 69th days respectively. Young fifth-stage and a few fourth-stage larvae were recovered from the brain of the first monkey autopsied. Examination of the third is not yet completed. M.B-B.

489—WEINSTEIN, P. P., ROSEN, L., LAQUEUR, G. L. & SAWYER, T. K., 1963. "*Angiostrongylus cantonensis* infection in rats and rhesus monkeys, and observations on the survival of the parasite *in vitro*." *American Journal of Tropical Medicine and Hygiene*, 12 (3), 358-377.

First-stage larvae of *Angiostrongylus cantonensis* obtained from 6 naturally infected *Rattus norvegicus* developed to the third stage in *Limax maximus* and *Deroceras reticulatum*. White rats proved to be adequate hosts when infected intra-oesophageally with larvae recovered from these slugs. The experimental infection of rhesus monkeys showed that development occurred in the brain, did not proceed beyond the fifth stage and was retarded when compared to that in the rat. The pathology is discussed extensively. Adult males survived *in vitro* for 64 days and females for 80 days in NCTC 109 supplemented with serum and containing antibiotics. Females deposited fertile eggs which embryonated within 5 to 6 days but after 3 or 4 days in culture, most of the eggs deposited were infertile. Hatching did not occur readily *in vitro* and first-stage larvae showed no growth in a variety of media. G.A.W.

*420—WESTERLUND, N. C.; CHAMBERLAIN, M., 1969. "Further observations on *Angiostrongylus cantonensis* in the Philippines." *Acta med. philipp.*, Ser. 2, 6 (1), 3-11.

Of 215 rats examined in the Philippines, 10 were found to be infected with *Angiostrongylus cantonensis*. The infected rats were from the Manila, Mount Salabusub and Mount Dilalan areas, and were of the species *Rattus norvegicus*, *R. mindanensis*, *R. everetti* and *R. lutiventris*. Larvae were found in 5 land snails: *Hemiplecta sagittifera*, *Achatina fulica*, *Helicostyla macrostoma*, *Chlorea fibula* and *Cyclophorus* sp. Larvae obtained from the 3 first-named snails developed to maturity when fed to young rats. [From *Trop. Dis. Bull.*, 67, No. 1934.] D.A.Cz.

2494—WOOD, D. E., 1965. "Experimental infection of a mongoose with *Angiostrongylus cantonensis* (Chen)." *J. Parasit.*, 51 (6), 941.

An *Herpestes urva* was experimentally infected with 1,000 3rd-stage larvae of *Angiostrongylus cantonensis*. First-stage larvae appeared in the faeces 33 days later. The animal was autopsied about 2½ months after infection and 5 adult *A. cantonensis* were recovered from the heart, 100 or more dead worms from the pulmonary arteries and large numbers of eggs and first-stage larvae from the lungs. T.Y.

3295—YANAGISAWA, T., 1967. "Some common species of pulmonate snails as the experimental intermediate host of *Angiostrongylus cantonensis* in Japan." *Jap. J. Parasit.*, 16 (5), 324-330. [Japanese summary p. 330.]

Some common species of Japanese snails (*Zonitoides arboreus*, *Allopeas kyotoensis*, *Fruticicola despecta sieboldiana*, *Euhadra peliomphala*, *E. quacita* and *Physa acuta*) were exposed to 1st-stage larvae of *Angiostrongylus cantonensis*. 3rd-stage larvae, which were all infective to *Rattus norvegicus*, were observed in all 6 species. The susceptibility of the snails is discussed. [A.S.] M.R.N.S.

1394—YANAGISAWA, T. & VON BRAND, T., 1965. "Carbohydrate metabolism in *Angiostrongylus cantonensis*." *J. Parasit.*, 51 (3), 418-423.

This is the first investigation of the metabolism of *Angiostrongylus cantonensis*. Both male and female worms consumed large amounts of glucose from the media *in vitro* and, on a weight basis, females consumed significantly more than males. Addition of inactivated serum to the incubation medium had no effect on glucose absorption. In the presence of 5% CO₂ females absorbed more glucose under anaerobic conditions than they did in oxygenated media; no such difference was found for males. Some of the glucose absorbed was used for glycogen synthesis. Under aerobic conditions, female worms synthesized glycogen only in the presence of CO₂; males were not tested under these conditions. Anaerobically, in the presence of CO₂, female worms formed glycogen while males showed a decrease in polysaccharide content. Most of the glucose absorbed by both sexes was degraded, the major product being lactic acid. Small amounts of keto acids were excreted under aerobic conditions; anaerobically, production of keto acids was reduced to the point where accurate determination was impossible. Production of volatile acids was not detected and, under aerobic conditions, females did not produce measurable quantities of succinic acid. No other conditions were tested for succinate production. Sugar consumption and lactic acid production were inhibited by iodoacetamide and iodoacetic acid, but not by sodium arsenite. More total carbohydrates than glycogen were present in the worms. Under starvation conditions more total carbohydrate disappeared from the worms than did glycogen. These results are discussed.

80—YII, C. Y. & CROSS, J. H., 1970. "Human angiostrongyliasis in Taiwan." [Demonstration.] *SEast Asian J. trop. Med. publ. Hlth*, 1 (1), 154-155.

192—BIOCCA, E., 1957. [Istituto di Parassitologia, Università di Roma.] "*Angiostrongylus chabaudi* n.sp., parassita del cuore e dei vasi polmonari del gatto selvatico (*Felis silvestris*).\" Atti della Accademia Nazionale dei Lincei. Rendiconti. Classe di Scienze Fisiche, Matematiche e Naturali. Rome. Serie 8, 22 (4), 526-532.

Biocca describes and figures *Angiostrongylus chabaudi* n.sp. from the heart and pulmonary circulation of *Felis silvestris* in central Italy. The new species most closely resembles *A. vasorum* (Baillet, 1866) and *A. raillieti* (Travassos, 1927) but differs from the first in the greater length of the spicules, 0.510-0.555 mm. against 0.360-0.400 mm., and the form of the caudal bursa and from the second in the larger, non-clavate oesophagus, the structure of the spicules and the form of the bursa.

W. G. Inglis

Angiostrongylus costaricensis

4417—MORERA, P., 1970. "*Angiostrongylus costaricensis*, un nuevo problema parasitario del hombre.\" [Abstract.] Congr. lat.-am. Parasit. (2nd), Mexico, 1970. Resúmenes, p. 7.

Angiostrongylus dujardini

1923—DOBY, J. M., DROZDZ, J. & BEAUCOURNU, J. C., 1970. "Existence en France d'un *Angiostrongylus* (nématode métastrongyloïdè) parasite de rongeurs sauvages.\" Bull. Soc. Path. exot., 63 (3), 376-381. [English summary p. 381.]

A new species of *Angiostrongylus* [description as *A. dujardini* n.sp. in press] was recovered from the pulmonary arterioles and right heart of *Apodemus sylvaticus* and *Clethrionomys glareolus* from 4 localities of southern France (all above 450 m.). *Helix* spp. were shown to be susceptible to first-stage larvae of the new species. If localization in the nervous system occurs during migration, this helminth may prove to be of medical importance.

M.R.N.S.

1233—DROZDZ, J.; DOBY, J. M., 1971. [Study of the migration of *Angiostrongylus* (*Parastrongylus*) *dujardini* Drozd et Doby, 1970 and of *A. (P.) cantonensis* (Chen, 1935) (Nematoda: Metastrongyloidea) in the body of the field mouse, *Apodemus sylvaticus* (L. 1758).] "Etude comparée des migrations d'*Angiostrongylus* (*Parastrongylus*) *dujardini* Drozd et Doby, 1970 et d'*A. (P.) cantonensis* (Chen, 1935) (Nematoda: Metastrongyloidea) dans l'organisme du mulot, *Apodemus sylvaticus* (L. 1758).\" C. r. Séanc. Soc. Biol., 165 (2), 417-420.

Apodemus sylvaticus were fed *Biomphalaria glabrata* infected with either *Angiostrongylus dujardini* or *A. cantonensis* and were killed one, 4, 24, 28, 32, 48 and 72 hours, and 7 and 12 days after the infective feed. More than 4,100 larvae and young adults were recovered; the mean per animal was about 100 but the range was from 22 to 442 for *A. dujardini* and 22 to 2,489 for *A. cantonensis*. The localization in the different organs was studied. *A. dujardini* migrated more slowly than did *A. cantonensis* but developed more rapidly. The first larvae of *A. cantonensis* reached the lungs in one hour; those of *A. dujardini* took 28 hours to get to the lungs but then remained in the pulmonary arteries and heart until they reached maturity, becoming 4th-stage larvae by 72 hours and young adults by the 7th day. Larvae of *A. cantonensis* continued to migrate and at 28 hours 95% were in the central nervous system (35% in the brain and cerebellum and 60% in the spinal cord); 4th-stage larvae were not found until 3 to 7 days and young adults were not found until between the 7th and 12th days. All the field-mice infected with *A. cantonensis* died within 12 to 14 days; it was, therefore, impossible to determine if this species would mature in the field-mouse. S.W.

5123—DOBY, J. M. & DROZDZ, J., 1971. "Cycle évolutif de *Angiostrongylus* (*Parastrongylus*) *dujardini* Drozd et Doby 1970 (Nematoda: Metastrongyloidea).\" C. r. heb. Séanc. Acad. Sci., Paris, Sér. D, 272 (4), 604-607.

The life-cycle of *Angiostrongylus* (*Parastrongylus*) *dujardini* from *Apodemus sylvaticus* and *Clethrionomys glareolus* in France has been investigated. The following molluscs were suitable intermediate hosts in which the 3rd-stage larva developed in 18 days: *Lymnaea* (*Galba*) *corvus*, *L. stagnalis*, *L. peregra*, *Planorbis planorbis*, *Planorbarius corneus*, *Hygromia limbata* and *Biomphalaria glabrata*. The definitive hosts, *A. sylvaticus* and *C. glareolus* were infected with larvae from 30-day-old infections of the molluscs, and killed at one, 4, 24, 28 and 32 hours, and at 2, 3, 7, 12, 16, 20 and 24 days after infection. The development of the larvae is briefly described, 4th-stage larvae being obtained 3 days after infection and adults after 7 days. One infection conferred immunity, since *Clethrionomys* which had lost their infection after 11 months could not be reinfected. White rats, hamsters and other rodents were infected with *Angiostrongylus dujardini*. *Pitymys subterraneus* was as receptive to infection as the normal hosts but 2 *Microtus agrestis* and one *Glis glis* died after infection. Rats also died but hamsters proved to be valuable laboratory hosts.

A.J.

Angiostrongylus gubernaculatus

48—Proceedings of the Helminthological Society of Washington.

- d. DOUGHERTY, E. C., 1946.—“The genus *Aclurostrongylus* Cameron, 1927 (Nematoda: Metastrongylidae), and its relatives; with descriptions of *Parafilaroides*, gen. nov., and *Angiostrongylus gubernaculatus*, sp. nov.” 13 (1), 16–25.

(48d) Dougherty has recently reviewed *Filaroides* and *Metathelazia* of the Filaroidinae [see Helm. Abs., Vol. XII, No. 102a]. He now gives a brief key to the 6 genera of that subfamily and lists the species and type hosts of the other 4 genera: *Parafilaroides* n.g. (for *Pseudalius gymmurus*), *Aclurostrongylus*, *Angiostrongylus*, and *Gurltia*. *Angiostrongylus gubernaculatus* n.sp., from the heart of *Taxidea taxus* and *Mephitis mephitis*, is described and figured. B.G.P.

Angiostrongylus michiganensis

- 908—ASH, L. R., 1967. “*Angiostrongylus michiganensis* sp.n. (Nematoda: Metastrongyloidea), a lungworm occurring in the shrew, *Sorex cinereus cinereus*, in Michigan.” *J. Parasit.*, 53 (3), 625–629.

Angiostrongylus michiganensis n.sp. from bronchioles of *Sorex cinereus cinereus* in Michigan, U.S.A., is distinguished from *A. soricis* by its greater size (male 5.6 to 7.6 mm., female 12.4 to 14.2 mm.), longer spicules (330 to 391 μ), and the more anterior position of the vulva (340 to 350 μ from tip of tail). It differs from *A. blarini* by its greater size and longer spicules. *A. blarini* occurs in fibrous cysts in the lung. Photomicrographs show lesions in the lungs. The author does not believe *A. cantonensis* should be placed in the genus *Rattostrongylus*. *A. pulmonalis* Sadvovskaya, 1954 is a *nomen nudum*.

R.C.A.

- 4660—DROZDZ, J., 1970. “Révision de la systématique du genre *Angiostrongylus* Kamensky 1905 (Nematoda: Metastrongyloidea).” *Annls Parasit. hum. comp.*, 45 (5), 597–603. [English summary pp. 597–598.]

Angiostrongylus is revised and divided into 2 subgenera, *A. (Angiostrongylus)* n.subg. and *A. (Parastrostrongylus)* n.subg. *A. (A.) vasorum* is designated type of the former which also includes *A. (A.) railletii*, *A. (A.) gubernaculatus* and *A. (A.) chabaudi*. *A. (P.) tateronae* is type of the latter which also includes *A. (P.) ondatrae*, *A. (P.) cantonensis*, *A. (P.) sciuri*, *A. (P.) mackerrasae*, *A. (P.) sandarsae* and *A. (P.) dujardini*. *Stefanskostrongylus* n.g. is proposed for those species of *Angiostrongylus* parasitic in the lungs of insectivores, namely, *S. michiganensis* n. comb. (type), *S. soricis* n. comb. and *S. blarini* n. comb. The 2 genera may be distinguished morphologically by the arrangement and relative size of the lateral and dorsal rays in the male bursa. A footnote records that since submitting this manuscript 2 other species have been described, *Rattostrongylus petrovi* Tardzhimanova & Chertkova, 1969, the description of which proved to be unobtainable to the author, and a species from Costa Rica, probably from man.

S.W.

Angiostrongylus pulmonalis

- 906—ASH, L. R., 1967. “*Angiostrongylus michiganensis* sp.n. (Nematoda: Metastrongyloidea), a lungworm occurring in the shrew, *Sorex cinereus cinereus*, in Michigan.” *J. Parasit.*, 53 (3), 625–629.

Angiostrongylus michiganensis n.sp. from bronchioles of *Sorex cinereus cinereus* in Michigan, U.S.A., is distinguished from *A. soricis* by its greater size (male 5.6 to 7.6 mm., female 12.4 to 14.2 mm.), longer spicules (330 to 391 μ), and the more anterior position of the vulva (340 to 350 μ from tip of tail). It differs from *A. blarini* by its greater size and longer spicules. *A. blarini* occurs in fibrous cysts in the lung. Photomicrographs show lesions in the lungs. The author does not believe *A. cantonensis* should be placed in the genus *Rattostrongylus*. *A. pulmonalis* Sadvovskaya, 1954 is a *nomen nudum*.

R.C.A.

Angiostrongylus sandarsae

4765—ALICATA, J. E., 1968. "*Angiostrongylus sandarsae* sp.n. (Nematoda: Metastrongyloidea), a lungworm of rodents in Mozambique, East Africa." *J. Parasit.*, 54 (5), 896-899.

Angiostrongylus sandarsae n.sp. from the pulmonary arteries of *Mastomys natalensis* (type host) and *Gerbil tatera* from Mozambique, has a gubernaculum and can, therefore, be easily separated from all other species except *A. gubernaculatus*. It can be distinguished from *A. gubernaculatus* by its shorter oesophagus (male 233 to 241 μ , female 235 to 264 μ), spicules (330 to 350 μ) and female tail (54 to 70 μ). Also, the ventroventral bursal ray in *A. sandarsae* is reduced and splinter-like. The histology of lungs of infected animals is briefly described and the author comments upon the validity of the genera *Angiocaulus* and *Rodentocaulus*. R.C.A.

Angiostrongylus sciuræ

448—MERDIVENCI, A., 1964. "A new lungworm, *Angiostrongylus sciuri* n.sp., parasitizing the venae pulmonales of the squirrel, *Sciurus vulgaris*." *Istanb. Üniv. Fen Fak. Mecm., Seri B*, 29 (3/4), 155-158. [Turkish summary pp. 155-156.]

Angiostrongylus sciuri n.sp. from the pulmonary vessels of *Sciurus vulgaris* from the Samsun area, Turkey, is described and figured. The new species differs from others of its genus in its body dimensions. P.S.G.

Angiostrongylus schmidtii

4668—KINSELLA, J. M., 1971. "*Angiostrongylus schmidtii* sp.n. (Nematoda: Metastrongyloidea) from the rice rat, *Oryzomys palustris*, in Florida, with a key to the species of *Angiostrongylus* Kamensky, 1905." *J. Parasit.*, 57 (3), 494-497.

Angiostrongylus schmidtii n.sp. from the pulmonary arteries of *Oryzomys palustris* in Florida, USA, is distinguished from *A. tateronae* and *A. sandarsae* by its shorter spicules and larger ventro-ventral ray. A key to the species of *Angiostrongylus* is given.

[A.S.] M.R.N.S.

Angiostrongylus raillieti

554—GRISI, L., 1971. [Occurrence of *Angiocaulus raillieti* (Travassos, 1927) comb.n. in *Canis familiaris* L. (Nematoda, Protostrongylidae).] "Ocorrência de *Angiocaulus raillieti* (Travassos, 1927) comb.n. em *Canis familiaris* L. (Nematoda, Protostrongylidae)." *Revta bras. Biol.*, 31 (1), 27-32. [English summary p. 31.]

Angiocaulus raillieti n.comb. for *Angiostrongylus raillieti* (Travassos, 1927) from the heart and pulmonary arteries of dogs and *Cerdocyon thous azarae* in Brazil, is described and figured. It is compared with other *Angiostrongylus* spp. and the presence of a gubernaculum is established. [See also No. 591 below.] P.S.G.

Angiostrongylus soricis

445—Acta Parasitologica Polonica.

SOŁTYS, A., 1953. "Helminthofauna ryjówkowatych (Soricidae) Białowieckiego Parku Narodowego." 1, 353-402. [English & Russian summaries pp. 389-402.]

(445) Sołtys gives short systematic notes of 25 helminths, collected from Soricidae by the Ecology Station at Białowieża, including the following six new forms which are illustrated by text figures: *Angiostrongylus soricis* n.sp. from *Sorex minutus* [not differentiated from allied species]; *Plagiorchis opisthocotellinus* n.sp. (for the specimen "C" of *Distomum exasperatum* (Rudolphi) which was described by Szidat in 1928) from *S. minutus*, *S. macro-pygmaeus* and *Neomys fodiens*; *Hymenolepis magnirostellata* forma 44 n.f. from *N. fodiens* which differs from the typical *H. magnirostellata* in having 44 hooks; *H. tridentophora* n.sp. from *N. fodiens* is 40 mm. to 60 mm. long, has 10 hooks (similar in size to those of *H. singularis* which is only 7 mm. in length) and hook guards with two highly characteristic finger-like processes; in *H. anacetabulata* n.sp. from *N. fodiens*, the scolex resembles that of *Dicranotaenia polyacantha* but does not possess the suckers which in *D. polyacantha* assist in fixing the scolex; *Dicranotaenia globosoides* n.sp. from *S. minutus*, *N. fodiens* and *N. anomalus milleri* is small and measures up to 2 mm. in length; in other respects it resembles *D. globosa* which, however, attains a length of 80 mm. and does not contain many eggs. *Capillaria ventricola* Sołtys, 1952 is shown to be a synonym of *C. kutori* Ruchladićwa, 1946, and *C. urinicola* Sołtys, 1952 to be a synonym of *C. capillaris* (Linstow, 1882) Stiles & Stanley, 1932. The article concludes with two parasite-host tables of the helminths of the European species of Soricidae.

R.T.L.

4660—DROZDZ, J., 1970. "Révision de la systématique du genre *Angiostrongylus* Kamensky 1905 (Nematoda: Metastrongyloidea)." *Annls Parasit. hum. comp.*, 45 (5), 597-603. [English summary pp. 597-598.]

Angiostrongylus is revised and divided into 2 subgenera, *A. (Angiostrongylus)* n.subg. and *A. (Parastrongylus)* n.subg. *A. (A.) vasorum* is designated type of the former which also includes *A. (A.) railletii*, *A. (A.) gubernaculatus* and *A. (A.) chabaudi*. *A. (P.) tateronae* is type of the latter which also includes *A. (P.) ondatrae*, *A. (P.) cantonensis*, *A. (P.) sciuri*, *A. (P.) mackerrasae*, *A. (P.) sandarsae* and *A. (P.) dujardini*. *Stefanskostrongylus* n.g. is proposed for those species of *Angiostrongylus* parasitic in the lungs of insectivores, namely, *S. michiganensis* n. comb. (type), *S. soricis* n. comb. and *S. blarini* n. comb. The 2 genera may be distinguished morphologically by the arrangement and relative size of the lateral and dorsal rays in the male bursa. A footnote records that since submitting this manuscript 2 other species have been described, *Rattostrongylus petrovi* Tardzhimanova & Chertkova, 1969, the description of which proved to be unobtainable to the author, and a species from Costa Rica, probably from man.

S.W.

Angiostrongylus mackerrasaeAngiostrongylus tateronae

315—ERHARDOVÁ, B., 1960. [The helminth fauna of Muridae in Albania.] *Československá Parasitologie*, 7, 91-96. [In Russian: German summary p. 95.]

Examination of 34 Muridae specimens in Albania revealed *Hymenolepis diminuta*, *H. horrida* and *Rodentolepis asymmetrica*, *Syphacia obvelata*, *Heligmosomum skrjabini*, *Angiostrongylus tateronae*, *Thomox gastrica*, *Trichuris muris*, *Rictularia prouti* and *Gongylonema neoplasticum*. *A. tateronae*, of which 2 males were found in the heart of an *Apodemus mystacinus*, is a new record for Europe. The paper is illustrated with line drawings. N.J.

439—BHAIBULAYA, M., 1968. "A new species of *Angiostrongylus* in an Australian rat, *Rattus fuscipes*." *Parasitology*, 58 (4), 789-799.

Angiostrongylus mackerrasae n.sp. was found in the pulmonary arteries and right ventricle of *Rattus fuscipes* (type host) from the rain forest of Mount Glorious, Queensland, Australia. Mixed infections of *A. mackerrasae* and *A. cantonensis* were found in *R. norvegicus* from Brisbane; the latter was much more numerous in these rats. The new species was not found in *R. rattus* in Brisbane or in *Melomys cervinipes* from Rathdowney and Mount Glorious. Spicules of *A. mackerrasae* n.sp. are less than half as long as those of *A. cantonensis*, the postero-lateral ray is usually the same length or longer than the medio-dorsal ray, and the posterior end of the female ends in a minute projection. The new species is also differentiated from other members of the genus by its size, form of the female tail, bursa characteristics, and position of the vulva and phasmids.

R.C.A.

References to Angiostrongylus vasorum

4031—BRIZARD, A. & DORCHIES, P., 1968.

"Action du tetramisole sur *Angiostrongylus vasorum*. Essai de traitement spécifique de l'angiostrongylose du chien." *Revue Méd. vét.*, 119 (12), 1089-1100. [English, German & Spanish summaries pp. 1099-1100.]

Tetramisole was active against *Angiostrongylus vasorum* in vitro and, in dogs, a subcutaneous injection of 0.1 ml. per kg. body-weight considerably reduced the number of *A. vasorum* larvae in the faeces. The dose was well tolerated when given subcutaneously or intravenously. D.A.Cz.

2577—GONÇALVES, P. C., 1961. "*Angiostrongylus vasorum* (Baillet, 1866), novo parasito do cão no Rio Grande do Sul (Brasil)—(Nematoda, Metastrongylidae)." *Revista da Faculdade de Agronomia e Veterinária da Universidade do Rio Grande do Sul*, 4 (1), 35-40. [English & German summaries p. 39.]

Angiostrongylus vasorum, found in a dog, is reported for the first time from Brazil. The paper is illustrated with six diagrams and two photomicrographs. N.J.

1952—GUILHON, J., 1960. [Laboratoire de Parasitologie, Ecole Nationale Vétérinaire d'Alfort, France.] "Rôle des Limacides dans le cycle évolutif d'*Angiostrongylus vasorum* (Baillet, 1866)." *Comptes Rendus des Séances de l'Académie des Sciences. Paris*, 251 (20), 2252-2253.

Molluscs of the genus *Arion* were collected in the south-west of France where *Angiostrongylus vasorum* is endemic (in kennels 30% to 80% of dogs were infected) and were fed to three dogs born at Alfort and Paris, far from the endemic zone. The first dog, aged four months, received 25 molluscs and died 14 days later of a virus infection; no trace of larval or adult *A. vasorum* could be found. The second dog, aged three years, received 14 molluscs over three days; it died 48 days after the first feed after showing dyspnoea and weight loss for 12 days. 10 mature and 83 immature males and 185 mature and 11 immature females of *A. vasorum* were counted from the right side of the heart. The lungs were dark red with light patches containing eggs but no larvae. The third dog, aged 20 months received a total of 34 molluscs over the period 10th to the 15th of September. On the 21st of October a dry cough started and the usual symptoms became progressively more pronounced. On the 3rd of November larvae appeared in the faeces. On the 6th of November the dog died. Autopsy showed 1,206 ovigerous females and 615 well developed males in the right heart and ramifications of the pulmonary artery; numerous early larvae were present in the lungs, bronchi, trachea and digestive tract. This is the first experimental evidence of the need for at least one obligatory intermediate host in the life-cycle of *A. vasorum*. W. M. Fitzsimmons

1229—GUILHON, J., 1963. "Recherches sur le cycle évolutif du strongyle des vaisseaux du chien." *Bulletin de l'Académie Vétérinaire de France*, 36 (10), 431-442.

The slug *Arion ater* is an intermediate host of *Angiostrongylus vasorum*. Guilhon lightly infected a 3-year-old bitch with this nematode. The bitch remained in good health, produced uninfected puppies and passed a steady 200 to 500 larvae per gm. of faeces even after a course of treatment [no details given] which did not cure the infection but appeared to have stabilized egg production. *Arion ater* and *A. rufus* were experimentally infected with *Angiostrongylus vasorum*. Most of the slugs died quickly; in the foot of the few which died 17 days after infection, various very active rhabditid nematodes and some strongyle larvae, with one or two sheaths and 2 small, chitinous, rod-like structures at the anterior end, were observed. Infection of *Agriolimax agrestis* produced only 1st-stage larvae, probably because of temperature fluctuations in the laboratory. Further experiments to assess the role of different ambient temperatures in the infection of dogs with *Angiostrongylus vasorum* are planned. L.E-L.

2851—GUILHON, J., 1965. "Evolution larvaire d'*Angiostrongylus vasorum* (Baillet, 1866) dans l'organisme d'Arionides." *C.r. hebdomadaire. Séances Acad. Sci., Paris*, 261 (20), 4225-4227.

First-stage larvae of *Angiostrongylus vasorum*, experimentally fed to *Arion rufus* and *A. ater*, required at least 17 days at 18 to 23°C. to develop to 3rd-stage larvae. First-stage larvae grew rapidly from about 300 to 500µ and were only slightly mobile or immobile in the slug's muscle. Structural changes on the 7th day indicated the imminence of the first moult which occurred before the 10th day. The first cuticle was retained and was clearly visible with the anal orifice on the 11th day. By the 15th day the larvae had moulted again and retained the 2nd cuticle and 2 small dark triangular masses appeared at the anterior extremity; these did not appear to develop further after the 17th day, by which time the larvae were able to emerge easily by their own movements. 3rd-stage larvae became infective when they were 3 or 4 days old but remained alive in the slug for at least 6 months. Those remaining longest in the slug before infecting dogs developed more quickly (60 to 42 days) when eventually transferred. D.W.L.

- 2481—GUILHON, J., 1965. "Transmission d'*Angiostrongylus vasorum* (Baillet, 1866) aux canidés sauvages." *C. r. hebd. Séanc. Acad. Sci., Paris*, 261 (21), 4496–4497.
- Arión rufus* were exposed to 1st-stage larvae of *Angiostrongylus vasorum* and after allowing 60 days for 3rd-stage larvae to develop, were minced and fed in pellets of meat to 2 foxes and a jackal. 3rd-stage larvae appeared in the faeces of these animals 43, 66 and 64 days respectively after the infective meal. Canine angiostrongylosis appears to be confined to the south-west of France and this work supports the suggestion that wild canines in the wooded areas of Aquitaine constitute a reservoir of *A. vasorum*. D.W.L.
- 2635—GUILHON, J., 1966. "Cycle évolutif d'*Angiostrongylus vasorum* (Baillet, 1866)." [Abstract.] *Int. Congr. Parasit. (1st), Rome*, Sept. 21–26, 1964. Proceedings, Vol. I, pp. 33–34.
- 3577—GUILHON, J., 1967. "Angiostrongylin nematodes and human eosinophilic meningitis." Seminar on Helminthiasis and Eosinophilic Meningitis, Noumea, New Caledonia, June 5–16, 1967. Noumea: South Pacific Commission. Working Paper No. 4, 5 pp.
- 133—GUILHON, J., 1968. "Spécificité d'*Angiostrongylus vasorum* (Baillet, 1866)." *Helminthologia*, Year 1967–68, 8–9, 171–172. [English, Russian & German summaries p. 172.]
- Investigations on the life-cycle of *Angiostrongylus vasorum* showed that it is not specific to the dog, but can also parasitize *Canis aureus* and *Vulpes vulpes*. M.R.N.S.
- 4293—GUILHON, J., 1969. "Angiostrongylose canine et incidences sur la santé humaine." *Bull. Soc. Path. exot.*, 62 (2), 411–421. [English summary pp. 419–420.]
- Although 10 to 15% of dogs examined in Toulouse (France) are infected with *Angiostrongylus vasorum* there is no evidence of human eosinophilic meningitis in France. This difference from the situation in the South Pacific area is attributed to the lack of neurotropism during the internal migrations of larvae. Nevertheless the possibility of eosinophilia being caused by larval migration, especially in children eating small slugs or contaminated plants, cannot be excluded. S.W.
- 4261—GUILHON, J. & AFGHAHI, A., 1969. "Évolution larvaire d'*Angiostrongylus vasorum* (Baillet, 1866) dans l'organisme de diverses espèces de mollusques terrestres." *C. r. hebd. Séanc. Acad. Sci., Paris*, Sér. D, 268 (2), 434–436.
- Thirteen terrestrial molluscs (*Helix pomatia*, *H. aspersa*, *Cepaea nemoralis*, *Arianta arbustorum*, *Euparypha pisana*, *Succinea putris*, *Cochlodina laminata*, *Limax cinereo-niger*, *H. cincta*, *H. lucorum*, *Otala lactea*, *Cochlicella acuta* and *Discus rotundatus*) from France, Spain, Morocco and Turkey were maintained in humid terraria at 18 to 23°C. They were given 1st-stage larvae of *Angiostrongylus vasorum*, either on lettuce leaves or by placing the larvae in drops of water on the retracted foot of the mollusc. After 17 days, living 3rd-stage larvae were recovered from the first 7 mollusc species listed. One to 5 snails of 4 of the species (*H. pomatia*, *H. aspersa*, *Cepaea nemoralis* and *S. putris*) were fed to 4 dogs and all 4 became infected. The dog fed *C. nemoralis* continued to pass living 1st-stage *A. vasorum* larvae for more than 2 years. S.W.
- 639—GUILHON, J.; BÉNEX, J.; MISHRA, G. S., 1971. [Initial attempts at the immunological diagnosis of canine angiostrongyliasis due to *Angiostrongylus vasorum*.] "Premier essais de diagnostic immunologique de l'angiostrongylose canine à *Angiostrongylus vasorum*." *Bull. Soc. Path. exot.*, 64 (2), 220–228. [English summary p. 227.]
- Gel immuno-precipitation, immuno-electrophoresis, complement fixation, latex agglutination and skin test were used to examine the reaction between a whole body, delipidized *Angiostrongylus vasorum* antigen and sera from dogs experimentally infected with *A. vasorum*. Antibodies were first detected on the 6th day after infection coinciding with the presence of L₄ and L₅ larvae in the abdomen. The antigen appeared to be specific showing no reaction with sera from uninfected dogs or from one *A. cantonensis*-infected dog, and it may prove useful in diagnosing those cases of human eosinophilia of uncertain aetiology probably due to *Angiostrongylus* migration in the body. P.S.G.
- 640—GUILHON, J.; CENS, B., 1970. [Attempts to transmit *Angiostrongylus vasorum* (Baillet, 1866) to the cat.] "Essais de transmission d'*Angiostrongylus vasorum* (Baillet, 1866) au chat." *C. r. hebd. Séanc. Acad. Sci., Paris*, Sér. D, 271 (11), 936–939.
- Cats were experimentally infected with 1,000 to 2,000 3rd-stage larvae of *Angiostrongylus vasorum* in the tissues of *Biomphalaria glabrata*. The larvae survived for at least 35 days, reaching sexual maturity in the pulmonary artery. In a 2nd series of experiments, 2 cats were given subcutaneous injections of heterologous protein (albumen) at 5 ml. daily for 10 days. 2 days later, they were given 1,150 and 1,300 3rd-stage larvae, respectively, followed by injections of 1 to 2 ml. albumen on the next day. 53 days after infection no first-stage larvae had appeared in the faeces but, on autopsy of one cat, 24 female and 19 male worms were found in the pulmonary artery and some eggs in neighbouring capillaries. No first-stage larvae were found in the faeces of the 2nd cat, killed 72 days after infection, and autopsy revealed only discrete pulmonary lesions, caused by parasites which had subsequently disappeared. It was concluded that injections of heterologous protein increased the life-span of the parasite in the cat by approximately 20 days but without allowing the elimination of first-stage larvae in the faeces. A.J.
- 1328—GUILHON, J.; CENS, B., 1969. [Migrations and development of *Angiostrongylus vasorum* (Baillet, 1866) in the dog.] "Migrations et évolution d'*Angiostrongylus vasorum* (Baillet, 1866) dans l'organisme du chien." *C. r. hebd. Séanc. Acad. Sci., Paris*, Sér. D, 269 (24), 2377–2380.
- Twenty-six dogs were orally infected with 1,000 to 4,250 3rd-stage larvae of *Angiostrongylus vasorum* in the tissue of *Biomphalaria glabrata*. The larvae penetrated the lymphatic vessels in the 24 hours after infection and moulted twice. Immature worms then passed through the blood vessels of the liver, reaching the pulmonary artery 9 to 10 days after infection. First-stage larvae liberated from eggs *in vivo* were passed in the faeces 40 to 45 days after infection. A.J.

5071—GUILHON, J. & GAALON, A. DE, 1966. "Éosinophilie sanguine et infestation expérimentale du chien par *Angiostrongylus vasorum* (Baillet, 1866) et par *Angiostrongylus cantonensis* (Chen, 1935)." *C.r. hebdomadaire. Acad. Sci., Paris, Série D*, 262 (8), 894–896.

The eosinophilia of 3 dogs experimentally infected with larvae of *Angiostrongylus vasorum* was more intense (26 to 63%) and prolonged than that of 3 dogs experimentally infected with larvae of *A. cantonensis* (13 to 26% eosinophilia). C.W.G.

4262—GUILHON, J. & GAALON, A. DE, 1969. "Évolution larvaire d'un nématode parasite de l'appareil circulatoire du chien dans l'organisme de mollusques dulçaquicoles." *C.r. hebdomadaire. Acad. Sci., Paris, Sér. D*, 268 (3), 612–615.

Following the successful infection of various terrestrial molluscs with *Angiostrongylus vasorum* [see No. 4261 above], Guilhon & de Gaalon exposed 9 freshwater species, including some tropical forms. Developmental stages were only observed in *Biomphalaria glabrata* from USA and Guadeloupe and in *Physa* sp. collected from tropical fish aquaria; both were kept at 25 to 27°C. The other molluscs (kept at 18 to 20°C.) died between 2 and 4 days after infection. The development in *B. glabrata* is described and compared with that of *A. cantonensis* in the same intermediary. S.W.

2063—GUILHON, J., MISHRA, G. S. & BÉNEX, J., 1970. "Étude de la réaction d'hypersensibilité cutanée (I.D.R.) au cours d'infestations expérimentales à '*Angiostrongylus cantonensis*' et à '*Angiostrongylus vasorum*'." *Bull. Soc. Path. exot.*, 63 (3), 367–376. [English summary p. 375.]

Ten dogs experimentally infected with *Angiostrongylus cantonensis* and 16 infected with *A. vasorum* were skin tested with an antigen prepared from *A. cantonensis* adults. The preparation and chemical analysis of the antigen are described. In *A. cantonensis*-infected dogs the skin reaction appeared within 40 min. of injection, formed an erythematous plaque 1.5 to 3 cm. in diameter, and persisted for up to 58 days. Skin test was positive 5 days before larvae appeared in the faeces. In *A. vasorum*-infected dogs the reaction (1 to 2 cm.) began one hour after injection but faded within 3 to 5 hours. Animals with infections of more than 48 days duration showed no reaction. P.S.G.

663—Wiener Tierärztliche Monatsschrift.

f. WIRTH, D., 1947.—"Lungenwürmkrankheit des Hundes." 34 (12), 768–771.

(663f) A case of fatal catarrhal pneumonia due to *Angiostrongylus vasorum* is described in an 18-months-old setter which had recently been brought to Vienna from near Boulogne. This infection had not previously been recorded in Austria. E.M.S.

672—MISHRA, G. S.; CENS, B., 1971. "Eosinophilic variations and electrophoretic analysis of plasma of dogs infected with *Angiostrongylus vasorum* (Baillet 1866)." *Indian vet. J.*, 48 (6), 633–640.

Ten dogs infected with varying numbers of infective larvae of *Angiostrongylus vasorum* showed a remarkable and proportional increase in γ -globulin and a marked decrease in albumin levels. β -Globulin was variable. During the course of canine angiostrongyliasis, 3 peaks of eosinophils were observed. These peaks appear to represent the phases of larval migration, growth and sexual maturity.

[A.S.] D.A.Cz.

2864—FALLASKE, G., 1967. "Zur Angiostrongylose des Hundes." *Dtsch. tierärztl. Wschr.*, 74 (6/7), 166–171.

A description is given of the clinical and histological changes found in a 4-year-old dachshund infected with *Angiostrongylus vasorum*. The right side of the heart was dilated and there was consolidation of the lung lobes and obstruction of the liver. K.H.

1954—ROCHE, M. M. & KELLIHER, D. J., 1968. "Angiostrongylus vasorum infestation in the dog: a case report." *Ir. vet. J.*, 22 (5), 108–113.

Angiostrongylus vasorum in a dog is reported for the first time in Ireland. P.S.G.

1424—ROSEN, L., ASH, L. R. & WALLACE, G. D., 1970. "Life history of the canine lungworm *Angiostrongylus vasorum* (Baillet)." *Am. J. vet. Res.*, 31 (1), 131–143.

The 3rd and 4th moults of *Angiostrongylus vasorum* of the dog, occurred in abdominal visceral lymph nodes and the parasites then migrated via the liver to the heart and pulmonary arteries where development was completed. *A. vasorum* was found in pulmonary arteries 10 days after infection, and first-stage larvae appeared in faeces as early as 49 days. One dog passed larvae for 5 years. Partial development of *A. vasorum* occurred in the lymph nodes of a rat. *Biomphalaria glabrata*, *Laevicaulus alte*, *Bradybaena similaris*, *Subulina octona* and *Prosopoeas javanicum* were suitable intermediate hosts. R.C.A.

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